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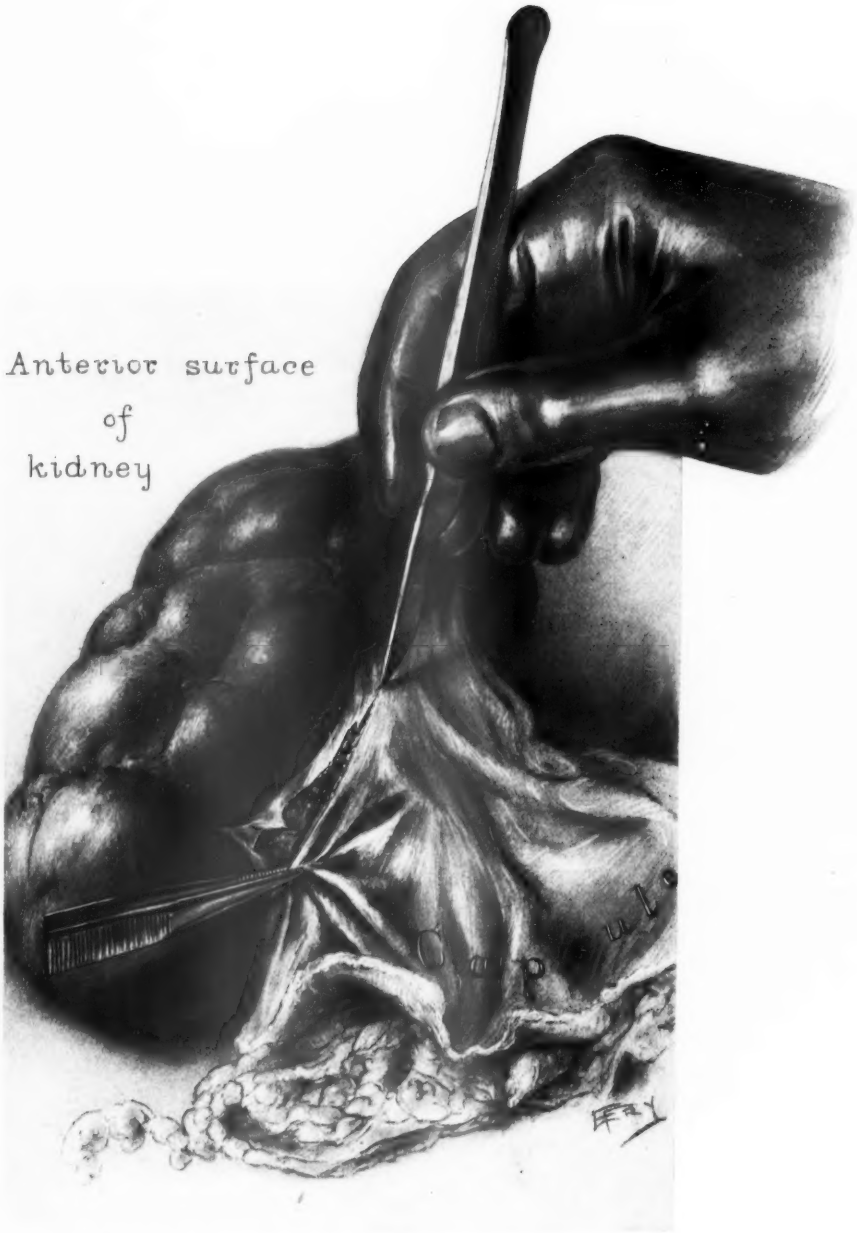

Fig. 4. Subcapsular nephrectomy for pyonephrosis. Kidney drawn outside of the capsule. Incision being made which separates the capsule from the kidney sinus.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

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THE REMOVAL OF STONES FROM THE KIDNEY[1]

BY WILLIAM J. MAYO, M.D., ROCHESTER, MINNESOTA

FROM January 1, 1898, to December 31, 1915, 450 patients with stone in the kidney were operated on in the Clinic (484 operations). Three died, a mortality of 0.6 per cent. This percentage represents the number of patients who died in the hospital without regard to cause of death or length of time after operation. The results achieved were due more to the painstaking care with which the diagnoses were made, the function of the kidney estimated, and the patients prepared for operation than to any purely technical feature of the procedures employed in removing the stones.

The presence of the stones was shown by the roentgenogram. By means of the pyelogram the urologist was able to say with certainty whether the stone was in the pelvis, calyx, or parenchyma of the kidney. On two occasions, previous to the use of the pyelogram, I exposed the right kidney on the basis of roentgenographic shadows only to find it free from disease and the stones which had given rise to the shadows, located in the gall-bladder directly anterior to the kidney. It is true that these shadows can usually be identified as gall-stones by their concentric layers and density, but, as Carman points out, an occasional shadow may be confusing.

Stones in both kidneys. Forty-eight patients (9.9 per cent) had stones in both kidneys. A kidney containing small movable stones is more liable to exacerbations of infection, the result of temporary obstruction, than a kidney containing large stones. The large stones, because of their more or less fixed condition, may not interfere with drainage, and therefore may be the cause of comparatively few symptoms even though the kidney is extensively damaged. Unless the condition in the opposite side is acute, our practice has been to remove the stone from the least involved kidney first, the second kidney being operated on after the patient has recovered from the first operation, usually 10 to 14 days later.

Occasionally the second kidney has considerable function even when it contains a large, branched stone. The removal of such a stone may cause such severe lacerations to the already damaged kidney as to necessitate nephrectomy. On this account we have sometimes advised against operation on the second kidney unless symptoms necessitating it arise. Several patients of this description have gone for years without apparent progress of the disease.

In exactly half of our cases of stones in both kidneys, the second kidney was found pyonephrotic, a condition necessitating nephrectomy.

Stones with renal anomaly. In three instances stones were found in a single kidney and in two instances in a horseshoe kidney. The condition was diagnosed before operation as nephrolithiasis in an anomalous kidney. In two cases in which the renal condition had not been diagnosed, considerable diffi-

[1] Presented before the Iowa and Illinois Central District Medical Association, Rock Island, Illinois, August 15, 1916.

culty was encountered, not in removing the stone, but in determining the presence of a congenital single or horseshoe kidney. When the diagnosis had been made previously, the stone was readily removed from the affected portion. No complications followed in any case.

In one case of horseshoe kidney the stone had caused a pyonephrosis in the left half. This portion of the kidney was resected and recovery followed.

Renal stones were found in two patients with duplication of the renal pelves. In both, the caudal pelvis was involved; in one, a pelviolithotomy sufficed but in the other a resection of the upper half of the kidney was necessary.

Stones in the remaining kidney after nephrectomy. Stone formation or re-formation in the remaining kidney after nephrectomy is an uncommon occurrence. In our series there were only two known instances. I have been greatly impressed with the fact that some persons can maintain, not only life, but working power, with what amounts to not more than half a normal kidney. The following is an example:

Case A44090, male, traveling salesman, age 44 years; had had stones removed from the right kidney and a nephrectomy of the left kidney for pyonephrosis four years before; was admitted to the hospital April, 1910, with stone in the remaining kidney. The patient was uræmic and had œdema of the lower extremities. The function of the kidney was so greatly impaired and the condition so serious that an operation was not advised. However, the patient and his family realized the situation, and urged that the stone be removed; it was accordingly done, a large soft stone being removed from a badly damaged kidney. The man made such a good recovery that he was able to go back to work. Two and one-half years later he returned with recurrence of stone, infection, and uræmia. He was then operated on by Charles H. Mayo, again made a good recovery, and was able to resume his work. Three years later he returned in a similar condition and, although extremely uræmic, rallied from the operation and returned to his occupation.

Recurrence. Multiple stones in the parenchyma of the kidney are prone to recur. In one case in which I removed 28 stones from one kidney and 26 from the other, I re-operated on the patient within two years for stones in both kidneys. Grave symptoms gradually developed each time the stones re-formed. It is possible that in the few cases of this type which have come under our observation, the stone formations were secondary to hæmatogenous infections of the cortex. Fortunately, multiple parenchymatous stones in both kidneys occur but rarely; according to Braasch they were found in but 5 of 48 cases of bilateral stones.

Persons having large and branched stones located in a hopelessly damaged and infected kidney are exceedingly liable to recurrence of stone following a conservative operation and therefore, if the remaining kidney is sound, there is an increasing tendency on the part of surgeons to remove the affected organ at the primary operation. Previous to the nephrectomy, urologic examination will have demonstrated the absence or the great reduction in functional capacity of the affected organ and will have shown that it is infected beyond permanent restoration to even limited function. In our experience one of the most common causes of recurrence of stone has been attempts to conserve a badly damaged kidney which was of little use functionally and a continuous menace to the future health of the patient.

If both kidneys are involved extensively, it will of course be necessary to save them both. After the removal of the stones under these circumstances, the pelvis of the kidney should be drained by a rubber tube through the cortex, and each calyx containing a stone, which has extended out into the parenchyma by atrophy necrosis until it can be felt with the finger as a softened area in the cortex, should also be drained separately through a counter-puncture. Drainage provides an opportunity for the relief of the infection and also for contraction of the large renal cavities from which the stones were removed. Drainage must be thorough and effected by means of a rubber tube and rubber tissue rather than gauze. Gauze drainage tends to leave a fistula which is slow to heal. Small cigarette drains, however, are satisfactory for the drainage of the calyces and smaller stone-containing pockets, but a tube should be used for drainage of the pelvis.

Recurrence of stone is sometimes due also

to attempts to remove the stone through a too-small incision. In these attempts the stone is crushed or fragments are loosened from it which remain in the urinary tract to be painfully passed out later by way of the ureter or to become the nidus of a secondary kidney stone.

Another error to which Braasch has called attention is the fact that, in cases of multiple stones, roentgenograms may show only a single shadow, because the several stones are superimposed upon each other. We, therefore, should not trust entirely to the roentgenogram as to the number of stones present. We must produce all the stones that are shown by the roentgenogram and then introduce the finger into the pelvis and cavities to see that no others remain. On one occasion after a stone corresponding in location, size, and general appearance to the finding in the roentgenogram was removed from the pelvis, a second roentgenogram made before the patient was discharged from the Clinic showed a small stone which had remained hidden. To prevent these failures, a roentgenogram of the kidney is now made in every case of operation for the removal of stone before the patient is discharged from the Clinic. It has been stated that we cannot know whether or not stones have re-formed in a kidney unless a roentgenogram has been taken. Unfortunately, however, unless a roentgenogram is taken immediately after the operation, we have no means of knowing whether stone shadows in a subsequent roentgenogram are those of stones that were overlooked or of new stones.

Our experience shows that the percentage of recurrence of stone will be small, certainly under 10 per cent, if at the primary operation good judgment is exercised in selecting and carrying out the best surgical procedure for each individual case.

SURGICAL TREATMENT

Hospital organization and operating-room technique have been so standardized that during an operation sepsis is rarely introduced from without. With good exposure the surgeon is able to properly handle septic renal conditions and prevent soiling of the operative field from within. Next to soiling from septic contents of the kidney itself, lack of proper hæmostasis is the most frequent cause of those processes which directly or indirectly, lead to sepsis and death, or those secondary conditions which end in recurrence of stone, hernia, or other sequelæ.

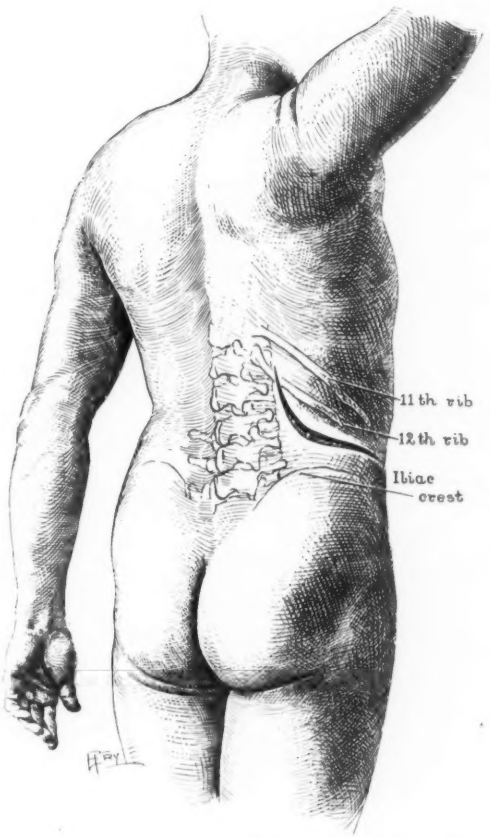


Fig. 1. Proper incision for operations on the kidney.

The incision outlined in Fig. 1, and which I have described previously, mobilizes the lower wall of the thorax, enables adequate exposure of the kidney, and does not result in injury to important nerves or other structures. As pointed out by Charles H. Mayo more than fifteen years ago, a cross cut of muscle when properly sutured is almost never followed by hernia. On the contrary the muscle-fibers have little cohesion and are

Fig. 2. Pelvis of the kidney sutured. Fatty fascial flap replaced, following pelviolithotomy.

held together laterally by aponeurotic coverings on which structures the protection against hernia in muscle-splitting operations rests.

Pelviolithotomy, 206 cases. Pelviolithotomy is the most generally useful operation for stone in the kidney. As shown by Brodel, the anterior row of calyces and the anterior half of the posterior row in about 95 per cent of the cases are supplied by the anterior renal arteries and the kidney is notched on the posterior surface. In the small remainder the contrary is true. The kidney is separated from its fatty capsule and brought well up into the wound so as to expose the pelvis in the notch. If the stone is felt, it is removed by direct incision, and a search is made with the finger within the pelvis for others. The pelvis is then sutured with catgut, the kidney dropped back into position, carefully surrounded by its fatty covering (which should not have been lacerated in the separation), and two or three rolls of rubber tissue are introduced into the kidney space to provide temporary drainage. If the stone cannot be felt, needling or pummeling in an effort to confirm the X-ray diagnosis injures the kidney and serves no good purpose. The pelvis of the kidney should be exposed by dissecting the fatty tissues back from it in a flap-like manner, and the stone located by the finger introduced through an incision into the pelvic cavity, and removed. The capsule should then be sutured with a few interrupted sutures of catgut, and the fatty fascial flap, to which I have previously called attention, placed and sutured in position (Fig. 2). The kidney should then be dropped back within the fatty capsule and the rubber-tissue drains introduced. Drainage of the pelvis of the kidney is rarely required after pelviolithotomy for uncomplicated stones in the pelvis. If necessary, it should be done not through the pelvis, but by counter-puncture through one of the calyces, preferably the posterior inferior calyx.

Combined pelviolithotomy and nephrolithotomy, 34 cases. While usually it is possible to remove stones situated in the calyces through the renal pelvis, the communication between the renal pelvis and the calyx may be so small as to cause fragmentation of the stone in attempts at removal. Moreover, much cortical infection may be present about the stone, necessitating drainage. With the finger in the pelvis, a counter-puncture permitting easy removal of the stone should be made in the cortex above it and a drain inserted. Stones may be removed in this way from several or all the calyces. Each cavity should be drained separately; at least one tube should lead to the renal pelvis.

Nephrolithotomy, 40 cases. Nephrolithotomy is an operation we seldom perform for uncomplicated stones in the pelvis and calyces. It injures the kidney and is liable to be followed by secondary hæmorrhage by way of the ureter, beginning four to ten days after

operation. The hæmorrhage may be so severe as to necessitate the removal of the kidney to check it. Several of our patients had hæmorrhages after operation, and in 4 it was necessary to do nephrectomy to save their lives. This, of course, is an extremely high percentage, and does not represent what might be called the normal incidence of secondary hæmorrhage, since the stones were removed from the kidney through the cortex, not as an operation of choice, but only for good and sufficient reasons. It was done, for instance, in secondary operations when the kidney was firmly fixed as a result of former operation.

The rule is that if a stone is removed from an infected kidney by nephrolithotomy, a drain is introduced through the cut cortex of the kidney into the pelvis; otherwise drainage is unnecessary. If a number of stones are present and there is atrophy necrosis in various areas of the kidney-substance over the stones, it is wise to drain each cavity separately. Small cigarette drains are excellent for the purpose.

Nephrectomy, 204 cases. In not a single instance in which nephrectomy was performed was there reason to regret the removal of the kidney either after examining the specimen or in the later events of the patient's history, while in a number of instances in which a conservative operation had been performed the necessity for secondary nephrectomy after some months or years of trouble made it evident that the excision of the kidney would have been the better primary operation.

In the larger number of cases in which nephrectomy was done there was pyonephrosis and stone, and nephrectomy was obviously the only treatment that could be considered. Four nephrectomies were performed following conservative operations for stone. In the small number remaining in which nephrectomy was done the function was so limited as to be negligible but it would have been possible to save the remnant of the kidney. Should this have been done? Since stone did not form or re-form in the remaining kidney in any of these cases and no symptoms developed subsequently to indicate renal insufficiency we must conclude that the practice followed was sound. In most cases, nephrectomy is easily done through the incision described, but in some cases, especially of pyonephrosis, the kidney may be encapsulated by a massive wall of connective tissue and the attempt to remove it with the protective wall may cause the accidental opening of the pleura or more often of the peritoneal cavity. While neither of these accidents are of great moment (and I have never seen trouble follow if the pleural or peritoneal rents were promptly sutured with catgut), it is at least unnecessary. The most serious risk in the removal of such a kidney with its capsule lies in the fact that on the right side the vena cava or the duodenum may be injured during the operation.

Fig. 3. Subcapsular nephrectomy. Capsule incised along the superior border, of the kidney and enucleation begun.

In 1900, Dr. A. J. Ochsner and I saw Tuffier do a subcapsular nephrectomy. The opportunity to see this operation was alone worth the trip to France. In this country the mortality for nephrectomy in such conditions up to that time had not been far from 25 per cent. After exposing the kidney, Tuffier

made an opening through the fibrous capsule down to the pyonephrotic sac and, with the hand, quickly decorticated the kidney. He then lifted it out from within the attached capsule which turned back about the pedicle (Fig. 3), placed a pair of clamps across the pedicle, cut the kidney away and packed the cavity with gauze. On my return I described this method, and I believe that subsequently subcapsular nephrectomy with the forceps treatment of the pedicle lowered the mortality of nephrectomy for pyonephrosis in America very materially. But the forceps method was clumsy and painful. It was possible, of course, by the use of catgut on a needle, to tie off the pedicle in sections and so avoid using the clamps, but if there had been soiling of the field there was danger that the needle and catgut passing through the pedicle might infect the vein. One patient in our series died from general septicæmia which I believe had this origin.

In May, 1914, while on a visit to Petrograd, I saw that master surgeon, Federoff, make an addition to subcapsular nephrectomy which rendered the securing of the pedicle extremely easy. Drawing the kidney out of its capsule, with a knife he separated the capsule from the sinus of the kidney as it was folded back over the pedicle. This allowed the kidney with the renal vessels to be drawn through the capsule, top and bottom, and made possible separate ligation of the vessels (Fig. 4, frontispiece).

The most difficult nephrectomies are those which must be done following a nephrotomy which has left a fistula leading to a remnant of kidney. The safe way is to introduce a knife through the fistula to the kidney, and then split all the outer wall until a sufficient opening has been made for subcapsular nephrectomy (Fig. 5). If forceps are left on the pedicle, the admonition of Price should be remembered: Unclamp the forceps at the proper time — 48 to 72 hours — but do not remove them until from 8 to 12 hours afterward in order that the tissues firmly compressed may have an opportunity to retract. Should the forceps be removed at once after unclamping, the ends of the vessels in their bite may be torn apart, permitting hæmorrhage. In case there is a drainage tube in a fistula leading to a calcareous pyonephrosis previously operated, on the drain should be removed several days before the nephrectomy, to reduce the local irritative infection.

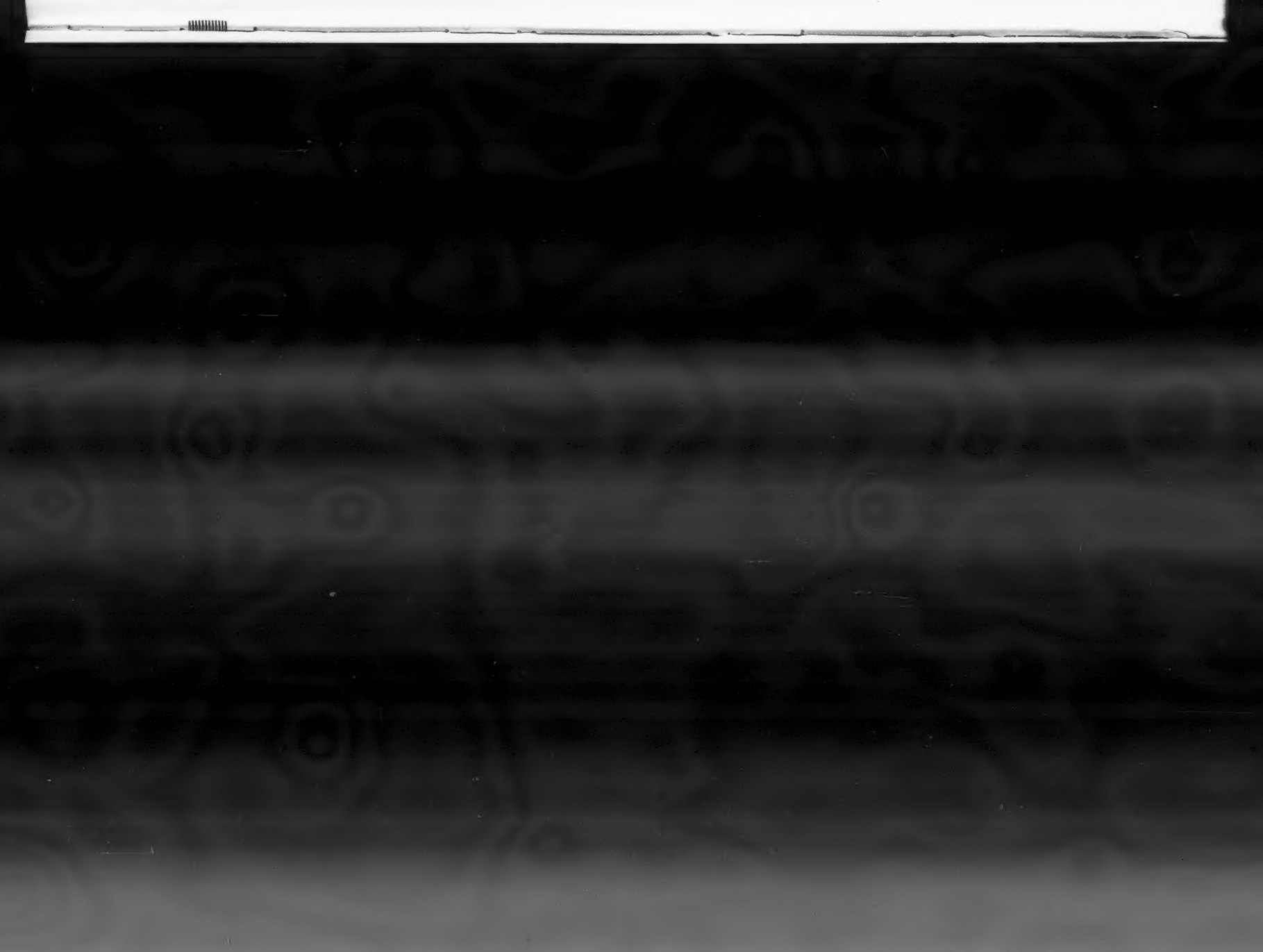
COMPLICATIONS AND ACCIDENTS

Exploration. In a small percentage of cases requiring operation it is impossible for the urologist to determine the exact condition of each kidney by means of cystoscopic data or functional tests. In such cases, therefore, exploration of each kidney becomes necessary. In this exploration, three methods may be employed: (1) examination of the presumably sound kidney before operating on the kidney known to be affected; (2) exposing the affected kidney and judging from its condition the probable functional capacity of the remaining kidney; and (3) opening the peritoneal angle of the incision described and exploring the second kidney with the hand, intraperitoneally. The latter method is not of great value unless the kidney to be examined is grossly affected.

Intraperitoneal complications can be readily detected through the peritoneal incision. Exploration of the gall-bladder, appendix, spleen, pelvis, etc., can be easily done and may yield information of great value.

Obesity. In very fleshy persons or occasionally those with crippling deformities, such as hip ankylosis, it may not be possible, with safety, to bring the kidney sufficiently into the wound to remove the stone. Sometimes fracture of the twelfth rib just behind the angle will give sufficient space. In other instances, I have removed enough perirenal fat to expose the kidney *in situ*, much as one would expose the uterus within the peritoneal cavity.

Hæmorrhage. In performing an operation on the kidney, large renal veins are occasionally injured, flooding the field with venous blood. I have checked this hæmorrhage by using catgut on a small needle and there has never been anything about the convalescence of the patient or the function of the kidney later to show that harm resulted. Injuries of the vena cava can be controlled in the same manner. Occasionally, however, renal



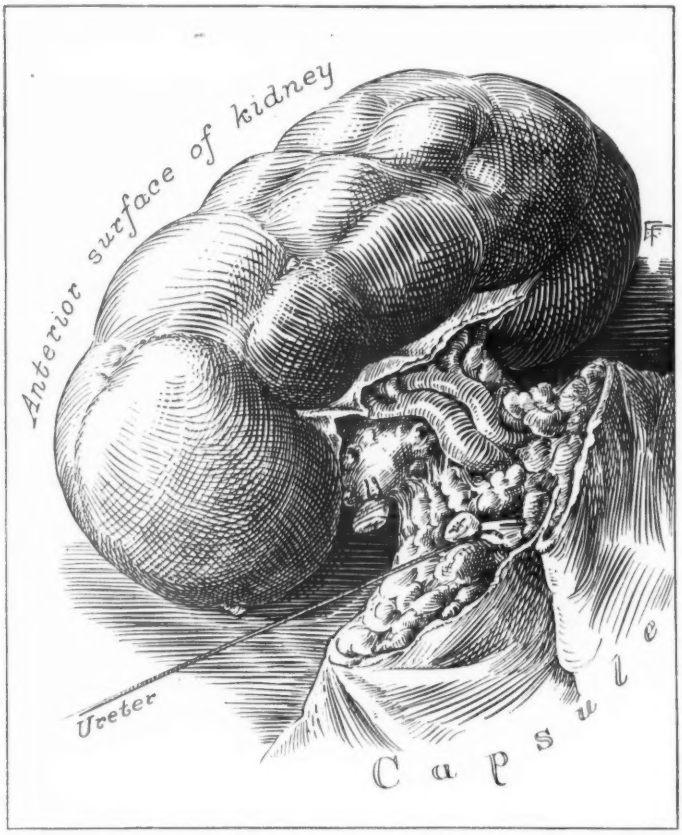


Fig. 5. Subcapsular nephrectomy for pyonephrosis. Ureter tied and divided. Kidney drawn away from the capsule, exposing the renal vessels.

arteries of considerable size have been injured. In one such instance there was a secondary hæmorrhage and it was necessary to take the kidney out at the end of twelve days. I was astonished to see that the injury and ligation of this large branch of the renal artery had resulted in acute degeneration of almost the entire kidney. This is what we might expect from animal experimentation and would indicate that while conservation should be practiced when veins are injured, primary nephrectomy may be better when there is injury to large arteries.

Laceration of the pelvis of the kidney. In the attempt to explore the interior of the pelvis and calyx of the kidney with the finger, the pelvis of the kidney may be considerably lacerated, but in our experience, if it is sutured with catgut and a fatty fascial flap is carefully applied about it, primary healing has always taken place. This is equally true in those cases in which the pelvis is badly lacerated in the removal of large stones. In a most difficult pelviolithotomy, I once completely detached the pelvis from the kidney. It was re-attached with fine catgut sutures, which, in some situations at least, did not bring the separated fragment of the pelvis directly in contact with the part from which it had been torn. The suture line was covered with a fatty fascial flap and good union and function resulted.

Injuries to the duodenum. I have already described elsewhere injuries to the retroperitoneal duodenum. Such injury occurs on the right side and usually is the result of the use of rat-toothed forceps in a hasty attempt to check hæmorrhage from the pedicle of a kidney which has slipped. Rat-toothed forceps should never be used hastily in the control of hæmorrhage in a situation where important organs may be injured, especially since it is so easy to control the hæmorrhage by catching the vessels with the thumb and fingers. The artery fairly jumps into the fingers as the stream of blood leads the way to it, and a pair of mouse-toothed forceps can then be applied for temporary control. When injury to the duodenum does occur, the accident will show at the end of a few days as necrosis permits escape of the duodenal contents. The patient thus injured will die within three weeks unless the abdomen is opened anteriorly, the retroperitoneal part of the duodenum exposed and the fistula sutured.

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CLINICAL DATA OF NEPHROLITHIASIS[1]

By WILLIAM F. BRAASCH, M.D., ROCHESTER, MINNESOTA

FROM January 1, 1898, to January 1, 1916, 450 patients were operated on at the Mayo Clinic for nephrolithiasis. The total number of operations, including those for recurrence and bilateral stone, was 484. A review of the clinical records, both pre-operative and postoperative, gives data of considerable interest.

Identification of shadows in the roentgenogram. It was not long ago that surgical explorations were made for renal stone because of a history of pain referred to the region of the kidney. Today the surgeon would rarely make such an exploration without previous X-ray examination. However, although we depend on the X-ray for our diagnosis of renal stone, an increasing reaction has developed against its infallibility in recent years. It has frequently happened that the roentgenogram has shown a shadow which appeared to be stone, but at operation no stone was found. It has also happened that no shadow has appeared in the roentgenogram, and at operation even large stones were found. It is now well recognized that the roentgenogram may lead to considerable diagnostic error unless its interpretation is aided by cystoscopic and allied data. The mistakes are principally of two types: (1) error in interpretation, and (2) failure to show the stone shadow. Error in interpretation has been largely eliminated through the aid derived from the cystoscope and particularly from pyelography. Failure on the part of the X-ray to show a shadow still persists in a small percentage of cases but it is usually the result of error in roentgenographic technique. Interpretation of the roentgenogram without complete clinical and cystoscopic data is inaccurate, and operation based on such evidence alone is not good surgery.

Localization of stone. The localization of the stone is of as much importance in the diagnosis as the identification. It is obvious that if exact localization is made prior to operation, the removal of the stone is facilitated, first, by guiding the operator in his search, and, second, by suggesting the most feasible method of procedure. When the shadow is large (an inch or more in diameter) the surgeon does

[1] From the Mayo Clinic.

not, as a rule, have much difficulty in finding the stone; when, however, it is smaller, considerable difficulty may arise in finding the stone in the kidney which usually becomes congested and enlarged when brought to the surface. The exact situation of a stone in the kidney is often difficult to determine in the original roentgenogram. By outlining the renal pelvis in a pyelogram and then comparing it with the position of the stone shadow, the stone can be localized more accurately than in the ordinary roentgenogram. The main problem in the localization of the stone is to determine whether it is situated in the true pelvis, in a calyx, or in the cortex. If situated in the pelvis the shadow may be obscured by the pelvic outline and the exact position can be determined only by comparing the pyelogram with the original roentgenogram. Frequently, however, the outline of the stone is visible through that of the pelvis. When the stone is situated in a calyx, its outline may be seen through that of the calyx which is usually characterized by definite deformity. When the stone is in a calyx, the comparative size of the calyx may be ascertained and this may be of value in determining the possibility of removing the stone through the pelvis. When the stone is situated partially in a calyx and partially in the cortex, its outline may be seen extending beyond that of the calyx. When situated in the cortex, the stone may be seen clear of the pelvic outline.[1]

It is also true, however, that when the stone is very small, say less than one centimeter in diameter, the question may well arise whether it should be considered as surgical. Since when in the pelvis or calyces a large proportion of such small stones are passed spontaneously, it is usually better to postpone operation, unless the symptoms become severe or some complication arises. Even when the stone has been localized in the cortex, it is often advisable in the absence of marked symptoms to await a moderate degree of increase in its size. The mutilation of the kidney substance in the search for a very small stone may cause considerable permanent destruction of the tissue.

[1] For further data refer to Braasch, W. F. Pyelography, Chapter vii.

Situation of the stone. A review of the cases in which operation was preformed shows that the situation of the stones, other than those found on nephrectomy, was as follows: 180 in the pelvis; 14 in the pelvis and calyces; 12 in the pelvis and cortex; 20 in the calyces; 48 in the cortex; and 8 at the ureteropelvic juncture. Since stones found in the calyces and at the ureteropelvic juncture are in portions of the pelvis, we have a total of 222 cases (78 per cent) with pelvic stone. The number of cortical stones was 60 (21 per cent). Exact localization of the stones was impossible in many of the cases of nephrectomy because of the wide-spread destruction of tissue, but as far as could be ascertained the number of stones situated in the pelvis and cortex was about equal.

Multiple stones. Renal stone was found to be single in 285 operations and multiple in 188. The large proportion of the multiple stones may be explained, in a measure, by the fact that with most of the patients of this group the symptoms were of long duration. The several stones usually form at different intervals over a period of years, and it is evident that this process, together with destruction of the kidney, could be largely prevented by early operation. Multiple stones occurred in 124 cases of pyonephrosis requiring nephrectomy, and the consequent renal destruction prevented exact localization. In many cases of this group in which the stones were localized in the cortex they evidently occurred secondarily to larger pelvic stones. The location of the multiple stones in the other operations was as follows: pelvis 24, calyx 6, cortex 16, pelvis and calyx 10, pelvis and cortex 8. From this it may be inferred that where multiple stones are found there is such destruction of kidney tissue that nephrectomy will be necessary in more than 60 per cent.

It may be inferred also that multiple stones, when primary, occur more frequently in the pelvis and calyces than in the cortex. In many cases in which multiple stones were found at operation, only a single shadow was present in the roentgenogram previously made; in others there was one definite shadow together with one or more other shadows

which could not be definitely interpreted as due to stone. In many instances it was necessary to make a very careful search of the entire kidney in order to find the various stones. Therefore, we should not always be content with the roentgenographic evidence as to the number of stones present, and the surgeon should make a careful search for more than one stone even though the roentgenogram may show only a single shadow. It is probable that in many cases reported as recurrence of renal stone one or more stones were not found at the time of the first operation and the remaining stones were regarded as recurrences.

Coincidence of stones in the kidney and ureter. A stone was found in the ureter and the kidney on the same side in 26 patients (5.7 per cent). This is of interest as it indicates the necessity of plates showing both the kidney and the entire ureter. When there is a definite stone shadow in the area of the kidney, a small shadow in the ureter may be easily overlooked. The data derived from the cystoscopic examination, ureteral catheter, and pyeloureterogram are frequently necessary to identify a shadow of this kind. The question frequently arises as to the best method of surgical procedure in this complication. Whether or not the stone in the ureter should be removed first depends largely on the degree of function in the affected kidney. If, on cystoscopic examination, it is found advisable to save the kidney, it is usually well to remove the ureteral stone first. When the function of the kidney is largely destroyed, nephrectomy is indicated as the primary procedure. When a large irregular stone remains in the ureter, it is advisable to remove it at a secondary operation. When the stone is small, however, and the ureter is not extensively dilated, it may not be necessary to remove the stone at all. When there is considerable dilatation of the ureter due to the stone, it may be advisable to perform a ureteronephrectomy. As a rule, no urinary leakage from the bladder by way of the remaining ureter will develop even though the ureter is greatly dilated. We have observed two cases, however, in which this has occurred and necessitated subsequent ureterectomy. Also, occasionally, when a thick, dilated, and infected ureter is left, a fistula discharging a small amount of thick pus may persist and necessitate subsequent ureterectomy.

Branched stone. Seventy-six stones were described as being distinctly branched. Counting only operations other than nephrectomy where exact localization was not possible, the stone was found in the pelvis and calyces in 22 cases and in the substance of the kidney in 14. It is evident, therefore, that branched stones are found more frequently in the pelvis and calyces than in the cortex. As a rule, branched stones found in the pelvis are much larger than those in the cortex and follow the outline of the various calyces. Even though a branched stone almost fills the pelvis, it may cause few symptoms, since it may not alter its position so as to interfere with the urinary excretion. The branched stone is frequently soft, casts a very dim shadow in the roentgenogram, and at operation often crumbles into a sand-like substance. Not infrequently what appears to be a single branched stone in the roentgenogram proves at operation to be made up of numerous smaller parts which are so grouped as to give the appearance of a single branched stone. The amount of renal secretion remaining with a large branched stone is frequently amazing. There may be but little gross evidence of renal lesions in the urine, and but a few microscopic pus-cells or red blood-cells. The various operations found necessary were as follows: nephrectomy, 40 cases (52 per cent); pelviolithotomy, 16 cases (21 per cent); nephrolithotomy, 14 cases (19 per cent); and combined nephrolithotomy and pelviolithotomy, 6 cases (8 per cent).

Bilateral stone. Bilateral occurrence of stone was noted in 48 patients — 9.9 per cent of the total number operated on. This, however, does not represent the entire number of cases of bilateral stones examined at the Mayo Clinic. Up to 1916 the clinical records show that 24 patients with bilateral nephrolithiasis were examined, but not operated on. A large proportion of this number were regarded as better off without operation because of the absence of subjective symptoms or the large size of the stones. A smaller

number was found to be inoperable because of the advanced destruction of the kidney or secondary infection. The symptoms were not regarded as being sufficiently severe to require operation. If we were to include all cases in which the diagnosis was evident but in which no operation was performed, the percentage of bilateral occurrence would be higher. At operation the stones were found situated as follows: In the cortex on both sides in 10 cases; in the cortex on one side and in the pelvis on the other in 14 cases; in the pelvis on both sides in 10 cases (in the kidney on one side and in the ureter on the other, 3 cases); and in the pelvis on one side associated with pyonephrosis on the other in 14 cases.

Previous operations. One hundred and forty-three patients, or practically one-third of the total number, had had previous laparotomies performed elsewhere for relief of pain. Of this number, 83 had stone in the right kidney, 55 stone in the left kidney, and 5 bilateral stone. It is evident that laparotomy was performed more often for stone in the right kidney than for stone in the left. It is of interest that 21 of the patients with stone in the left kidney had had previous operations on the appendix or gall-bladder.

Previous operations on the kidney done elsewhere were recorded in 23 cases. The operations were nephrectomy, partial or complete, 13 cases; nephrotomy 7 cases; pelviolithotomy 3 cases. At the time of the secondary operation, the kidney was found to be so largely destroyed in 14 cases as to indicate nephrectomy. After previous operation done elsewhere, a fistula persisted in 12 patients and in every case nephrectomy was found necessary. A fistula persisted in 3 patients following operation at the Mayo Clinic.

Passed stone. Fifty-three of the patients gave a definite history and 14 a somewhat questionable history of having passed a stone from the kidney prior to the operation. Eight described the pain at the time of passing the stone as being on the side opposite the kidney operated on. Seven patients evidently had passed stones from both kidneys. In the majority of cases, the stone was probably passed from the same side as that operated on. Single stones were passed in 23 cases, and more than one stone in 30 cases, which indicates that the passage of multiple stones is more frequent and is suggestive of a stone-forming tendency in the kidney.

At operation of those who had passed multiple stones (30) a single stone was found in 15 patients and multiple stones in 15. Of those who had passed single stones (23), single stones were found at operation in 16 and multiple stones in 7. From this it may be inferred that when multiple stones have been passed the chances for finding multiple stones at operation is greater than when single stones have been passed. As to the type of operation in this group, a nephrectomy was found necessary in 18 cases, nephrolithotomy in 18 cases, and pelviolithotomy in 16 cases.

Type of operation. The operations performed were divided as follows: nephrectomy in 188 cases; nephroureterectomy in 16; pelviolithotomy in 206; nephrolithotomy in 40; combined pelviolithotomy and nephrolithotomy in 34. The large proportion of cases in which nephrectomy was found necessary, 204 (41 per cent) is of interest. Most of the cases in this group were diagnosed clinically as pyonephrosis and stone. In the other cases the amount of healthy tissue remaining was so little that nephrectomy was clearly indicated. The stone was described as multiple in 124 cases (66.7 per cent) and single in 64 cases (33.5 per cent). With single stones, the pyonephrosis, as a rule, is secondary to the stone formation. With multiple stone, the stones are frequently formed secondarily to the inflammatory process. In many of these cases the duration of symptoms extended over a period of many years and the condition was either unrecognized or had remained dormant. Although the kidney was saved whenever it was possible, nephrectomy was usually deemed advisable in the presence of wide-spread destruction of the kidney tissue.

That pelviolithotomy is the operation of choice, when possible, is demonstrated by the comparatively large number of patients on whom it was done. In some instances, although the stone was situated in the pelvis or calyces, either nephrotomy alone or com-

bined with pelviotomy was preferable because of areas of tissue necrosis in the cortex requiring drainage. Removal of the ureter as well as the kidney was found necessary in 16 cases. In the majority of these there were one or more stones in the ureter with consequent marked dilatation and infection. It was feared that the dilated ureter might act as a diverticulum with secondary formation of stones or that it would become a focus of urinary infection. It is rare, however, that an ureter, even though markedly dilated, permits permanent reflux of urine from the bladder unless there is some malignant complication.

Perinephritic abscess was found in 10 cases. In 3 it was so extensive that preliminary drainage was first effected. In the others, however, nephrolithotomy or nephrectomy was done at the same time, usually the preferable procedure. This number does not include perinephritic involvements, such as fibrous adhesions or large deposits of inflammatory fat which are frequently found.

Mortality. As nearly as could be ascertained, the total number of patients who have died since the operation is 35. Of this number 3 died in the hospital because of the operation — an operative mortality of 0.6 per cent. It is of interest that no chemical estimate was made of the function of the remaining kidney, surgical judgment having been based on the grosser clinical findings together with careful cystoscopic and roentgenographic examination. The 3 deaths that occurred in the hospital followed nephrectomy for pyonephrosis and multiple stones. The symptoms were of long standing, and the patients were weakened and toxic as a result of the chronic infection. One died from septic pneumonia three weeks after operation, the second (an emergency case) from evident renal insufficiency, and the third died two weeks after operation with evidence of sepsis. It will be noted that there was no operative mortality following either nephrolithotomy or pelviolithotomy.

On reviewing the histories of the 32 patients who died subsequent to recovery from operation, it was found that 8 had bilateral nephrolithiasis. It is evident that the prognosis of bilateral stones is much more unfavorable than that of unilateral stones. In most of the 8 cases death occurred within one or two years after operation.

There were 22 deaths following nephrectomy for pyonephrosis and stones. Practically all of the patients had had symptoms of long standing prior to operation and on clinical examination showed effects of the chronic infection in other organs which evidently was the chief factor in shortening their lives.

As far as could be ascertained, the cause of death of the 32 patients was renal complications in 12 cases, and other causes in 7. In 13 instances the exact cause is not known but was evidently not renal. Besides the 3 patients who died immediately following the operation, 14 died within one year after, 5 from 2 to 3 years after, and 7 more than 3 years after. In 6 instances the date of death is not known. The after-course of patients subsequent to the operation was as follows: 43 were reported alive and well more than 10 years after operation; 121 more than 5 years after; and 110 more than 2 years after. The bulk of the operations, however, occurred within the last 5 years. The larger percentages of the subsequent deaths were due to renal complications, either bilateral nephrolithiasis nephritis, or infection in the remaining kidney. The majority of patients, as shown, died during the first year following operation.

Postoperative results. The frequency of the recurrence of renal stone has long been a disputed subject. Of considerable interest are the figures recently published by Cabot, who claims that among 66 patients previously operated on for renal stone at the Massachusetts General Hospital, and who were recently re-examined, recurrence of stone was found to be 49 per cent. Because of the wide geographical distribution of the patients operated on at the Mayo Clinic, it is impossible to make a re-examination in every case. However, complete clinical data including X-ray, urinalysis, etc. were obtained for 88 patients previously operated on for renal stone who returned to the Clinic for re-examination. Of these 88 patients, 13 (14.7 per cent) had re-

currence. This percentage of recurrences, however, is manifestly higher than that in all patients operated on, since nearly all of those re-examined had sufficiently definite symptoms to cause their return.

In a large number of cases (75) the findings on re-examination were negative, although many of the patients had definite aches and pains referred to either the renal area or the upper abdomen. From this it is very evident that positive subjective symptoms are not to be relied on. Occasional pain referred to the kidney area following a renal operation is not uncommon and may be explained either by functional causes or possibly a remaining renal infection, injury to a nerve, etc. Among the 75 negative cases, the roentgenogram showed a shadow either in the kidney or ureter in 5 patients. These shadows, however, were definitely proved to be extra-renal and extra-ureteral either by means of careful cystoscopic and pyelographic examination or surgical exploration. It is evident, therefore, that the presence of roentgenographic shadows alone in the kidney cannot always be regarded as absolute evidence of the recurrence of stone.

The urine of 8 of 69 patients found negative on roentgenographic examination showed red blood-cells and pus-cells, usually but few in number. This indicates that a mild degree of infection frequently persists for a long period after the removal of the stone, and the question may well arise whether such infection is not the original etiologic factor. In the 13 positive cases urinalysis showed the presence of red blood-cells or pus-cells to a variable degree in every case.

Of the 13 patients in whom a recurrence was found, 11 were reoperated on. In every case but one, the stones recurred in the same portion of the kidney as at the primary operation. In 2 instances the stone had been removed from the pelvis. In 1 it had been found in the cortex in the primary operation and the subsequent operation disclosed multiple recurrence with such destruction of the kidney that nephrectomy was necessary. Repeated recurrence requiring a third operation was noted with 2 patients only, the others remaining well after the second operation. In but 2 cases in which a nephrectomy had been done was recurrence noted in the opposite kidney. In another case a small stone was passed from the opposite kidney shortly after the operation, and it may be assumed that it was present but undiscovered at the time of operation. As Cabot has suggested, the rarity of the appearance of stone in the opposite kidney subsequent to nephrectomy must be regarded as indicating renal lithiasis to be dependent on anatomical factors. That bilateral stones have no particular tendency to recur is evident from the small number of recurrences noted, i.e., 5 cases (11.9 per cent).

In order to obtain information concerning the subsequent course of patients operated on for renal lithiasis and not re-examined, letters of inquiry were sent out asking detailed questions as to exact location and severity and time of any recurring attacks of pain. Two hundred and eighty-seven replies were received. From these it was inferred that 241 patients should be regarded as negative, 15 had probable recurrence, and 18 had passed stone some time following the operation.

Although, judging from a review of the symptoms of the 450 patients operated on, absence of well-marked pain does not necessarily exclude the possibility of recurrence of stone, this group constitutes a very small proportion of the total. In order to further study a few patients with doubtful symptoms, specimens of their urine were obtained for examination. With but few exceptions these were negative.

Fifteen patients had symptoms sufficiently positive to make it probable that they had had recurrence although we were unable to corroborate this by X-ray and cystoscopic examinations. With one exception specimens of urine contained pus-cells and blood-cells. It is of course probable that several of this group would show no recurrence on direct examination. This number would offset the possibility of error in the negative group.

Eighteen patients claimed to have passed stones following operation. In 4 cases, however, the pain was on the side opposite to that operated on. One patient had had a nephrectomy so that the recurrence must have been

on the opposite side. Several patients passed stones soon after the operation which in all probability were missed at the time of the operation. Although such stones should not be regarded as recurrences they have been included as such. Again it is probable that some of the "stones" were in reality blood-clots, mucus, etc. The addition of this entire number to the total of recurrences further offsets the possible percentage of error in the negative group. But 2 of this group required subsequent operation, so that although actual recurrence was probable, the group as a whole could not be regarded as having surgical recurrence. The fact that all patients who passed stone following operation had stone in the pelvis or calyces at the first operation bears out the contention previously made that recurrence usually takes place in that portion of the kidney where the stone was situated primarily.

Taking into account the number of patients whose X-ray examinations were positive (13), those with positive symptoms and urinalysis (15), and those with a history of having passed stones after operation (18), we have a total of 46 patients (9.8 per cent) who may be regarded as having had recurrence of stone. This is a liberal interpretation of the statistics at hand. It may be safely stated, therefore, that with accurate pre-operative diagnosis, operative technique, and judgment, the percentage of recurrence of renal lithiasis should be less than 10 per cent.

THE TREATMENT OF MALIGNANT DISEASE BY MEANS OF DEEP ROENTGENTHERAPY AND ELECTROTHERMIC COAGULATION[1]

By GEORGE E. PFAHLER, M.D., Philadelphia

THE elimination of cancer is probably the greatest medical problem of this age, and it is occupying the attention of many of the greatest minds throughout the world. The importance is well illustrated by the statements made in the introduction on the *Mortality from Cancer Throughout the World* prepared by Mr. Frederick L. Hoffman, statistician of the Prudential Insurance Company of America, and Chairman of the Committee on Statistics of the American Society for the Control of Cancer. He says that at ages of forty-five and older: "In our *ordinary* experience of 1914, 9.6 per cent of the deaths of males, and 18.6 per cent of the deaths of females were the result of malignant disease. This gives an average of over 14 per cent for the combined sexes." He also states that the mortality from cancer in the United States now exceeds 80,000 per annum, and that the rate of mortality from this disease is increasing approximately 2.5 per cent per annum.

When we realize that the intelligent application of the knowledge now at hand would prevent many, if not the majority, of all of these deaths, we can surely feel the strong call of duty and the deep responsibility that rests upon the medical profession to disseminate such knowledge and impress upon the general public the importance of eliminating all precancerous lesions as soon as they are recognized. While prophylaxis is not an actual part of my theme (the subject that I present is of much less importance), I would stop for a moment to emphasize the importance of eliminating irritations of the skin and mucous membrane, traumatism, and chronic inflammation to glandular structures, the removal by surgery or destruction by electrothermic coagulation of slowly healing wounds, ulcers, moles, warts, and benign tumors. When they cannot be made to disappear by simple measures, they should be removed surgically, or I believe better by electrothermic coagulation or electrical desiccation. In many instances, these benign lesions are neglected by patients because of their terrible fear of an operation. Such

[1] Read by invitation before the annual meeting of the Colorado State Medical Society, September 5, 6, and 7, 1916.

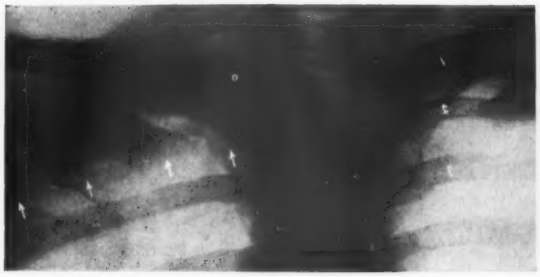

Fig. 1. Case 1. Mrs. B. General carcinomatosis. Roentgenogram of chest made February 20, 1914, showing destruction of at least there inches of the left second rib, due to metastatic carcinoma. See arrows.

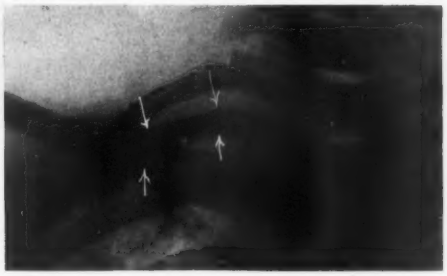

Fig. 2. Same case as Fig. 1. Roentgenogram made two years later, February 23, 1916, showing complete recalcification and healing of this rib. Other diseased bones were also found healed.

patients can often be induced to submit to electrothermic coagulation or electrical desiccation, and equally good or superior results can be obtained.

Another common cause of neglect of early malignant lesions or precancerous conditions is the soothing and comforting words of the family physician. I believe that the truth plainly told would accomplish better results, for I am sure more people die from neglect than from fright.

The means at our command that have been proved of definite value in the elimination of malignant disease from the individual patient consist in its aseptic removal by surgery, electrothermic coagulation, deep roentgentherapy, and radium. I believe that the intelligent combination of two or more of these methods will accomplish far more than any single method. Therefore, while I recognize the great and indispensable value of surgery in the treatment of malignant disease, I will confine my remarks to deep roentgentherapy and electrothermic coagulation, which are two methods that are not sufficiently well known, and that have been proved of great value.

The term "deep roentgentherapy" has been coined since the technique of crossfiring and filtration has been more perfectly developed, and the advent of the Coolidge tube which makes possible the use of a tremendous quantity of deeply penetrating rays which will permit of much filtration of the rays, and yet not overtax the patient's energy, or the time and patience of the operator in administering the necessary quantity. It implies what is now known to be a fact, that deep-seated malignant disease can be influenced by means of the roentgen rays.

THEORY OF THE EFFECTS OF THE ROENTGEN RAYS ON MALIGNANT DISEASE

The results obtained in the treatment of malignant disease depend primarily upon the exceeding sensitiveness of pathologic cells to the roentgen rays, for it is well known to all who have had experience with epithelioma, as an example, that with the same dose of rays given to the epithelioma and the surrounding tissue, the epithelioma undergoes degeneration and seems to melt away, while the surrounding healthy tissues may show no effect or no more than a little redness. It has been shown, too, by histologic studies made on tissues which have been subjected to the effect of the rays that these cells undergo degeneration before any effect is shown on the healthy cells. It is also well known that the more nearly cells approach the embryonal type the more sensitive they are to the rays, and among normal tissues the essential cells of glands are more sensitive than the stroma, and next to the glandular cells come the protective epithelium, such as the skin, mucous membrane, and intima of the blood-vessels, and next to this the connectives tissue cells.

Some very interesting and instructive studies of the microscopical changes taking place in the tissues of animals and human beings, have been reviewed and recorded by

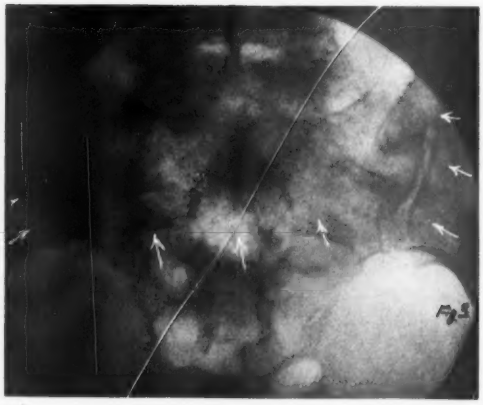

Fig. 3. Same case as Figs. 1 and 2. Roentgenogram made June 6, 1915, showing metastatic carcinoma involving two-thirds of the sacrum, and extending into the iliac bones on each side.

Collwell and Russ in their book on *Radium, X-Rays and the Living Cell*.[1]

Contamin,[2] has exposed tumors in mice to the X-rays under various experimental conditions, and draws the following conclusions:

1. The action of X-rays is the greater, the younger and more actively growing the tumor is.

2. The disappearance of a large tumor causes the death of the animal, probably by intoxication.

The disintegration products of the cells which have been injuriously affected by the rays are eventually absorbed by the body. In the case of excessive quantities this leads to a state of intoxication.

In one tumor examined by Contamin, only a small area, the size of a pea, was exposed, the remainder of the neoplasm thus serving as a convenient control. *The non-irradiated parts* of the growth presented the character of a glandular carcinoma, the cells having comparatively little cytoplasm and the nuclei being round or oval. In *the irradiated area*, the most marked change was the formation of cavities resembling cysts, which originated in the center of the cellular masses constituting the acini of the growth. In addition to this cystic change, a prominent feature was the marked increase in the amount of stroma. The cyst contents, after treatment with the usual histological fixing agents, presented a finely granular appearance, while in the largest cysts hæmorrhages were of frequent occurrence. These changes had taken place *four days* after the beginning of treatment. In the case of tumors removed *eight days* after the initial irradiation, cysts were, generally speaking, absent. The main feature was the enormous increase in the stroma and the consequent subdivision of the cell-masses into yet smaller islets, the sections presenting an appearance as if the cells were undergoing strangulation by the fibrous tissue.

The heredity of the characters imposed upon a tumor has been studied by Marie Clunet and Raulet-Lapointe.[3] These new characters which consist mainly of (1) a reduction in the percentage of successful grafts, (2) a reduction in the malignancy of the tumor, (3) a slower rate of growth and certain histological features of which the following were the most important; (a) the presence of "giant" cells, some cells being as much as four or five times their original diameter, (b) atypical mitoses, (c) basophile "giant" cells, having multiple nuclei.

They found as a result of the transplantation of tumors after irradiation had been entirely stopped that there is a tendency on the part of the cells to return to their normal condition, but even in the sixth generation there were many cells to be seen, showing the abnormalities (a), (b), (c), produced in the tumor-cells by their previous exposure to X-rays. The practical conclusion they draw is that if the malignant cells in the human subject gradually assume less and less malignant features when exposed to X-rays, this may only be manifested at some period remote from the time of exposure.

Clunet and Raulet-Lapointe have made elaborate researches into the nature of the changes produced in malignant cells in human subjects when subjected to X-rays. They removed sections during the course of treatment of nineteen cases of squamous-cell carcinoma of malpighian type in the human

[1] London: G. Bell & Sons, Ltd., 1915.

[2] Compt. rend. Acad. d. s.e, 1910, June 6.

[3] Bull. Ass. franc. l'etude du cancer, vol. IV.

subject. They state that before the ultimate disappearance of the growth, the cells pass through at least five successive phases which are characterized as follows:

1. The latent phase.
2. Development of monstrous characters.
3. Keratinization.
4. Disintegration and phagocytosis.
5. Formation of the connective-tissue scar.

Their illustrations are most convincing of the effects of the rays on tumor-cells. When sacromatous cells are exposed to X-rays, the same authors found that a somewhat similar transition in the cellular characteristics occurs, but the latent phase, during which no changes are observable, is very much shorter than in the other types of malignant growth considered; instead of being from 6 to 10 days, it is generally 1 or 2 days.

Nogier and Regaud,[1] have submitted evidence, based upon a clinical experience of more than one hundred cases of malignant growths, that there often occurs a gradual diminution in the sensitiveness of these growths to X-rays; the clinical indication is that when a growth is exposed for the first time to X-rays a marked diminution in its size may occur, but when the rays are again applied after an interval of some days or weeks, the same dose of X-rays does not now appear to be so effective, and succeeding applications of the rays may have no apparent effect upon the growth. The remaining cells of the neoplasm appear to have become more resistant to the rays. This observation by Nogier and Regaud agrees with my own observations, and I am sure that it agrees with that of all other men who have had a wide experience, and is of considerable importance from a radiotherapeutic point of view, for it should decide to some extent the method by which radiation is best administered to growths which exhibit this phenomenon. I believe that it teaches the lesson that the largest dose possible should be given to a tumor from as many angles as possible, in a single course of treatment, so that this resistance to the rays will not have time to be developed by the cells.

[1] Compt. rend. Acad. d. sc., 1914, June 8.

Fig. 4. Same case as Figs. 1, 2 and 3. Roentgenogram made a year later, June 29, 1916, almost three years after beginning treatment, showing marked recalcification, and probably healing of the sacrum and iliac bones.

TECHNIQUE IN ROENTGENOLOGY

I will have to be brief in the discussion of technique, but will refer those who are interested for other details to my previous papers[2] upon the treatment of malignant disease. Great improvements have been made in the technique of deep roentgentherapy within the past few years. These improvements consist *first* in the development of more powerful apparatus which will give rise to more penetrating rays. This involves primarily the Coolidge tube, but secondarily an apparatus which is capable of giving an output of a large quantity of current, but more particularly a current with a high degree of voltage. This development has permitted the *second*, which is equally important, consisting of extensive filtration of the rays which will reduce proportionately the rays affecting the skin. The *third* great improvement consists in the development of more extensive crossfiring. The improvement in apparatus is usually discussed thoroughly by manufacturers and from a commercial standpoint. Therefore, I shall

[2] See references at end of article.

confine my remarks to the improvements in filtration and crossfiring.

Filtration. My first experimental work upon animals and clinical work in the use of filters was done in 1905,[1] based upon the ground principles developed by Walters. At first I made use of a leather filter, consisting of a thickness of sole leather, for the purpose of eliminating the rays that are more or less distinctly absorbed by the skin. The great value of filtration was proved by the animal experiments[2] and by the subsequent clinical results, but since that time the filtration has been increased to a great extent. Two or three years ago I had increased my filtration to three millimeters of aluminum, and a layer of sole leather. At the present time, I am using six millimeters of aluminum, or its equivalent, in deep work. Generally I use at present four millimeters of glass and two millimeters of aluminum. This glass filtration has the advantage of serving as an insulator (23) and being less affected by the heat. The glass used has about the same absorbing value as aluminum. It must be clearly understood that this does not prevent or eliminate the possibility of X-ray burns, for one can still burn the skin seriously through any amount of filtration. It does, however, permit the administration of at least ten times the quantity of rays into the deeper tissues, and when this filtration effect is added to the crossfiring effect, we can increase our deep results perhaps one hundred times as much as we could do ten or fifteen years ago.

Crossfiring. In my very early work, ten or fifteen years ago, I used a certain amount of crossfiring in the treatment of disease, especially about the breast, but the real elaboration of the idea belongs to Gauss. This crossfiring requires a certain amount of engineering skill, but in general the object is to have the rays cross from as many angles as possible through the deeper portions of the tumor, and in crossing through the deeper portions of the tumor one is compelled to have treated all of the outer borders of the tumor and the lymphatic glands leading therefrom. Each area of skin through which the rays are passed to reach the central portion of the tumor is spoken of as a "portal of entry." The more portals of entry and the more angles from which one attacks the tumor within certain limits, the deeper the effect obtained. Each portal of entry should be carefully separated from the neighboring field by means of sheets of lead, carefully strapped to the skin by adhesive plaster so that there is a clear space of untreated skin of from one-eighth to one-fourth inch, for if these areas overlap at all, a burn will be produced. The more one multiplies these portals of entry, the more expense is incurred, and the more tiresome the treatment becomes to the patient. Therefore, one should be careful to keep within practical limits so that he may obtain good therapeutic results. Many other technical points have been discussed in previous papers, and therefore will not be repeated in this one.

[1] Arch. Physiol. Therapy, 1905, Nov.

[2] Proc. Am. Roentgen Ray Soc., 1906, Aug. 29.

DEEP ROENTGENTHERAPY COMBINED WITH OTHER METHODS

The roentgen rays have been proved of undoubted value in the treatment of malignant disease, but great as this value is, I believe that the greatest field of usefulness of deep roentgentherapy is in the postoperative treatment of malignant disease. This does not mean that a surgeon can cut away at random masses of malignant tissue, and leave definite malignant tissue behind, and then expect to control it and get the patient well by means of deep roentgentherapy. It means that when the surgeon does a clean surgical operation, such as he has been doing, the results will be tremendously improved if he would add the deep roentgentherapy in postoperative treatment. This subject has been dealt with in more detail in an article on the "Post-Operative Treatment of Carcinoma of the Breast" (24).

Roentgentherapy may also be combined with electrothermic coagulation to great advantage, and I believe in some instances with superior end-results over the combination of surgery and roentgentherapy. It is now almost my routine procedure to combine electrothermic coagulation with deep roentgentherapy in

Fig. 5. Case 2. General carcinomatosis. Roentgenogram made August 19, 1915, showing metastatic carcinoma in a number of the vertebræ, and in the tenth rib on the right, and the eleventh rib on the left, indicated by arrows.

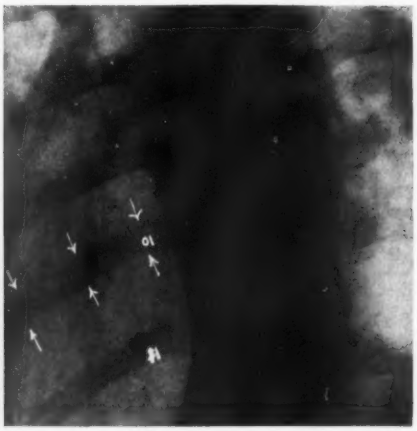

Fig. 6. Same case as Fig. 5. Roentgenogram showing recalcification of the tenth and the eleventh ribs, and to a considerable extent of the vertebræ.

the treatment of all superficial lesions, such as epitheliomata, degenerating moles, superficial sarcomata, and in nearly all epithelomata of the mouth. When the epitheliomata about the mouth are associated with glandular metastasis, I believe that the metastatic glands should be dissected out by the surgeon, and at times the blood-vessels ligated. I believe, however, that in the majority of instances, the destruction of the malignant disease within the mouth by electrothermic coagulation will give better results than will be obtained by surgical excision. In all this group of cases, however, I am quite sure that a conference between the roentgenologist and the surgeon will give the best end-results, for in each case there are certain debatable points which must be considered. The decision as to the best procedure will often depend upon the extent of the involvement, the general condition of the patient, the skill of the surgeon, and the skill of the one who is to do the electrothermic coagulation.

Roentgentherapy may also be combined with radiotherapy, but the roentgen rays and radium should never be applied through the same surface of skin or mucous membrane, for we are using two agents having the same general physiological effects on the tissues, and by doubling this effect, serious results may occur in the form of burns, which will prevent the future proper treatment of the patient. The two agents may be combined to advantage when radium is applied within cavities, directly within the tissues, as has been suggested by Burnham, within the open wound, or within the axillary space as has been suggested by Boggs, while the roentgen rays are applied externally, crossfiring upon the disease. In this way, one is simply adding another point of crossfiring.

Surgery, electrothermic coagulation, roentgen rays, and radium may all be applied in the same case to advantage in some instances. I have in mind particularly the mouth cases, such as I have described before the Dermatological Section of the American Medical Association at its annual meeting in Detroit, June 15, 1916 (20). In this way I am sure that we have obtained results that have never been equalled by any single method. Co-operation should be our watchword in medicine today, but especially in the treatment and control of malignant disease.

ELECTROTHERMIC COAGULATION

Electrothermic coagulation has been described by me previously in more detail (19 and 20). Briefly the process consists in the de-

Fig. 7. Same case as Figs. 5 and 6. General carcinomatosis. Roentgenogram made September 28, 1915, showing metastatic carcinoma of the glenoid process and the head of the humerus.

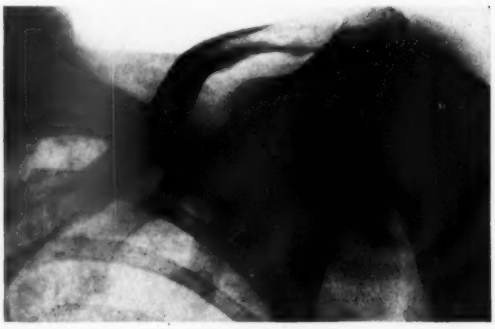

Fig. 8. Same case as Figs. 5, 6, and 7. Roentgenogram made June 19, 1916, showing recalcification and healing of the glenoid process and the head of the humerus.

struction of the malignant disease by coagulation produced by the heat generated in the tissues because of the resistance to the flow of the electrical current. The type of current used is the high-frequency of the d'Arsonval type. When used for destruction, it is synonymous with the term diathermy. It is also synonymous with the American understanding of the incorrectly used term "fulguration." It is nearly the same process as electrical desiccation, as described originally by Clarke, except that electrical desiccation involves the use of the Oudin current. I prefer the Oudin current and the electrical desiccation method for very superficial lessions, because it can be more delicately controlled, and less destruction of tissue occurs. In general, however, there is more danger to the welfare of the patient from too little destruction than from too much, for one must often sacrifice cosmetic results for permanency of results in the treatment of malignant disease.

It is a bloodless procedure: the diseased area is totally destroyed, and then either cut away by curved scissors or allowed to slough away. It is very painful, and must be done under either local or general anæsthesia. It is especially indicated in malignant disease about the mouth, such as the lip, tongue, gums, cheek, and tonsils, though in one case I successfully removed an inoperable carcinoma of the breast which was referred to me by the late Dr. Rodman. In all my experience, however, I have only seen one or two cases of carcinoma of the breast which were suitable for this treatment.

CLASSIFICATION OF CASES AND RESULTS OBTAINED

1. *Epithelioma of the skin.* I believe that by means of deep roentgentherapy, or better, the combination of deep roentgentherapy and electrothermic coagulation or electrical desiccation, that practically all epitheliomata of the skin can be completely and permanently cured unless they have extended to the deeper tissues and involve the cartilage or the mucous membrane, or the deeper tissues of the face such as the ethmoid cells. So, too, I believe that thorough surgical excision followed by roentgentherapy should produce a permanent cure in practically all cases. In treating the superficial epitheliomata, it is our custom to destroy completely the malignant tissue, together with a small area beyond the actual macroscopical involvement, by means of electrical desiccation, or electrothermic coagulation, and then follow immediately by a full dose of deep roentgentherapy. If the lesion is large, some means of local anæsthesia is usually required, for the destructive purpose. The roentgen rays are, of course, painless and not in the least objectionable. In the great majority of instances I believe that this first destruction and roentgentherapeutic application would be sufficient to produce a permanent cure, but it is my custom to treat the patient a

second time at the end of the month, and then, if convenient, two or three times more during a year in order that I may be quite sure of a permanent and successful result. At the subsequent visit, if there is the slightest doubt as to the total obliteration of the malignant disease, I give another application of deep roentgentherapy.

2. *Epitheliomata about the mouth.* In a recent paper before the American Medical Association, I described in considerable detail the "Treatment of Malignant Disease About the Mouth by Combined Methods" (20). In the present paper, therefore, I shall refer only very briefly to some of the results that may be expected.

a. *Epithelioma of the lip.* Of the *primary cases treated by X-rays alone,* 87 per cent recovered and remained well for from a few months to a year. Of the *primary cases of epithelioma of the lip treated by electrothermic coagulation and X-rays,* all have recovered and remained well from six months to seven years. Of the *primary cases of epithelioma of the lip treated by surgery and X-rays,* all have recovered, and all have remained well from two to thirteen years. Of the three cases with *local recurrences following excision, treated by the roentgen rays,* all have recovered. One has since died from intercurrent disease but had remained well several years. One other is well two years, and a third had in addition to the local recurrence, a small metastatic nodule in the submental region. This disappeared under X-ray treatment, and he has remained well seven years since. There were *two recurrent cases treated by X-ray and electrothermic coagulation.* They have remained well approximately a year each.

b. *Epithelioma of the tongue.* First, those involving the dorsum of the tongue. In this group there have been six cases. One patient who had also metastatic involvement did not recover. Four patients have recovered, and have remained well from one to four years. The sixth patient has been under treatment three months. The posterior two-thirds of the left side of the tongue was involved; ulceration had taken place. He was treated with radium placed in the fissure of the tongue, and deep roentgentherapy

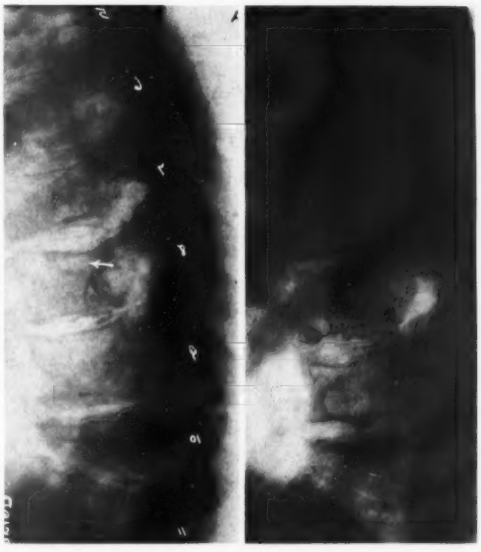

Fig. 9 (at left). Same case as Figs. 5, 6, 7, and 8. Roentgenogram made March 13, 1916, showing both the reparative and destructive processes going hand in hand, but especially marked destruction in the eighth, ninth, and tenth vertebræ, due to metastatic carcinoma.

Fig. 10. Same case as Figs, 5, 6, 7, 8, and 9. Roentgenogram made June 10, 1916, showing considerable recalcification of these vertebræ indicated by the sclerosis and increased density.

applied both inside the mouth and externally. This has shown marked improvement, even at the end of a month, and at the end of two months the ulcer had practically healed. There was some slight necrosis of the mucous membrane due to the action of the radium, this necrosis being shown both on the cheek and on the side of the tongue. I am hoping that he will recover.

c. *Epithelioma under the tongue and involving the floor of the mouth.* In this group there have been seven cases. All showed extensive disease. All were destroyed by electrothermic coagulation locally, followed by deep roentgentherapy. All healed primarily. Five developed recurrences, and three have died. There are still four under treatment. Two are free from recurrences. The seventh case, in which the epithelioma involved two inches of the side of the tongue, including the floor of the mouth, in an old man of 71,

Fig. 11. Case 3. Roentgenogram made February 29, 1916, showing marked destruction of the glenoid process and the humerus, due to metastatic carcinoma.

Fig. 12. Same case as Fig. 11. Roentgenogram made June 19, 1916, showing marked recalcification and repair of the diseased area under roentgen treatment.

at the end of two months shows complete healing with no evidence of malignant disease, and no induration of any of the tissues. He is still being kept under observation and given deep roentgentherapy in the tissues of the floor of the mouth and tongue.

d. *Epithelioma of the cheek.* First, without palpable glands. In this group there have been three cases, all developed upon the basis of leucoplacia. In only one was a section removed. This showed squamous-cell carcinoma. This patient has only recently been treated, but seems to be doing well. The other two have remained well two and three years respectively.

Second, epithelioma or carcinoma involving the cheek, gums, jaw-bone and the submaxillary glands. In this group I have treated a number of recurrent cases, and generally speaking the results have been disappointing. One may get temporary improvement, but so far all but one of the recurrent cases have been ultimate failures. *In the primary group, in which combined methods of treatment had been used, and in which there had been not previous destructive treatment, the results have been very encouraging even though the disease was very extensive.* In the paper previously referred to, which was read before the American Medical Association, June 15, 1916 (20), I reported nine cases belonging to this group in which the disease was very extensive, and in which results were obtained which I believe had not been equalled previously. For details of these cases, I will refer to this recent paper. In this paper, however, I will give a résumé of the results obtained in these nine cases, and will then report in more detail two of the cases as illustrations of the type of cases treated, the methods of treatment, and the results obtained. Of the nine cases reported in the above paper, eight patients are free from malignant disease from six months to three years. Of the eight cases there is no reason, from anything to be observed at present, to expect a recurrence. All of these patients have been observed from time to time by the surgeons associated with me and other surgeons visiting my clinic, and all agree that such results could not be obtained by any single method. The ninth case, which is dead, had been operated upon one month before I was privileged to see him, at which time the cervical glands were resected, but the growth in the mouth was not disturbed. In other words, he was considered inoperable at that time, The patient remained free from microscopical evidence of disease for approximately two months. He then developed a recurrence, which was not in the field of electrothermic coagulation, but in the field of surgery, and from this he ultimately died.

Case 6. Mr. J. L. P., age 58, was referred to me January 20, 1913, by Dr. H. W. Dachtler, roentgenologist, Toledo, Ohio, and Dr. H. E. Deemer of

Antwerp, Ohio. He had an epithelioma at the angle of the left side of his mouth about one and one-quarter inch in diameter, and involving half of the lower lip, and a third of the upper lip, and the whole inside of the cheek extending to the angle of the jaw. This whole diseased area was destroyed by electrothermic coagulation followed by deep roentgentherapy externally, and radium inside the mouth at the angle of the jaw. A course of roentgen treatment was given once a month until all evidence of disease had disappeared. February 21, 1914, when we felt sure that all evidence of malignant disease had disappeared, at my request, Dr. Laplace operated for the closure of his mouth with excellent results, and he is still well, approximately three years.

CASE 7. Mr. W. E. R., age 40, was seen in conference with Dr. Ernest Laplace and Dr. W. L. Shindle, June 10, 1915, at which time he had an epithelioma involving the entire inside of the left cheek, the gums on both the upper and lower jaw, the alveolar process of the upper jaw, almost the entire half of the left lower jaw, with a mass of metastatic glands in the neck. It had been growing at least eight months. It was considered surgically inoperable by Dr. Laplace. As a result of our conference, Dr. Laplace resected the metastatic glands from the left side of the neck. We then destroyed the disease inside the mouth by electrothermic coagulation; then resected the left half of the lower jaw, and followed by deep roentgentherapy externally, and into the open wound, with the radium capsule applied under the posterior surface of the upper jaw. In this way we were able to get entirely rid of the malignant disease. Microscopical section removed at the time of operation showed it to be a squamous-cell carcinoma. On October 3, 1915, as part of the necrotic bone was separating from the upper jaw, a severe hæmorrhage developed which could not be controlled until the internal carotid artery was ligated by Drs. Shindle, Gass, and Gill. On February 15, 1916, he returned free from malignant disease. The opening in the mouth had healed shut to within the size of a thumb, and by wearing a patch over this opening, he was able to eat all kinds of food, and he had returned to his occupation as traveling salesman. At this time Dr. Laplace sutured the two edges of the opening but there was too much tension, and the tissues separated again. A second attempt was made April 15, 1916, with similar result. He returned a few days ago still free from any malignant disease, and this time Dr. Laplace has made an effort to close the wound by means of the transfer of a skin flap. We are hoping for a complete success this time, and are very much gratified at the good result in the fight against the malignancy.

The general plan in treating this group of cases involves first the total destruction of the diseased tissue within the mouth by means of electrothermic coagulation, the destruction of any portion of diseased bone, the surgical removal of the metastatic glands under the jaw, and the resection of a portion of the lower jaw after it has been destroyed, or the total resection of half the lower jaw. Then we follow with very active deep roentgentherapy applied externally by crossfiring methods, and radium applied internally at the most likely point of recurrence. By the combination of these four methods, I am sure that many cases can be made well that otherwise would be considered hopeless.

Epithelioma of the tonsils. In this group I have treated four cases. One case which seemed to involve the tonsil by extension downward from the soft palate, and the anterior pillar of the fauces, has completely recovered, and has remained well almost three years. One other apparently recovered, and died from intercurrent disease. The third made a temporary recovery, but developed recurrence from which he died. The fourth made a recovery, and seemed to be free from disease for several months but has now developed metastasis under the jaw, and is still under treatment.

Carcinoma of the larynx. Carcinoma of the larynx should give good results from roentgentherapy, because one need not go through a great amount of tissue in order to reach the diseased area. The treatment should, of course, be begun as early as the diagnosis can possibly be made. I have treated three cases within the past two years.

CASE 1. Mr. F., age 69, was referred by Drs. William Teller and Arthur W. Watson, May 20, 1914. This tumor, which was located beneath the left vocal cord, was regarded by Dr. Watson as an adenocarcinoma. The patient received four courses of treatment within three months, each course consisting of twenty-five doses crossfiring upon the tumor in the larynx, and at the end of this time seemed to be well, and has received no roentgen-ray treatment since. I have been told that he is still well.

CASE 2. Mr. H. M. L., age 48, was referred by Drs. E. B. Gleason and Alex. A. Aaron. He had been suffering from a growth in the larynx for three years. Five weeks before being referred to me, a section was removed and examined by Dr. Funk who pronounced it epithelioma. He improved after the first course of treatment, consisting of nineteen doses. After the second course of treatment, which was repeated in one month, he was

improved so much that he believed himself to be well, and did not return for treatment for six months, at which time he had signs of recurrence from which he died. I believe that he would have had a reasonable chance of permanent recovery if he had reported for treatment at the time he seemed to be well.

The third case was a dispensary patient in whom there was some improvement obtained, but he did not recover.

Sarcoma of the mouth. In this group, I have had under treatment twelve cases. All have shown good results. In one there was metastasis to the spinal column, and ultimately death. In another the patient died of general sarcomatosis, though there was no local recurrence in the area treated. The others have recovered, or are improving.

The conclusions that I have drawn from malignant disease about the mouth are:

1. The cases forming the basis of this report, except those involving the lower lip, were almost entirely inoperable, and therefore every success is a distinct advance, and every failure only a loss of time, energy and effort.

2. Any lesion about the mouth which does not show a tendency to heal within a few weeks, should be looked upon with suspicion as being malignant, and when in doubt should be destroyed or removed.

3. I believe that early lesions about the mouth can be destroyed by electrothermic coagulation with less loss of tissue, and with more success than by any other means.

4. Deep roentgentherapy should be added to any other method of destruction or removal of malignant disease.

5. Combined treatment by surgery, electrothermic coagulation, radium, and deep roentgentherapy will make some patients well that are otherwise hopeless.

Recurrent and metastatic carcinoma of the breast, and metastasis from carcinoma of the breast. There is probably no field in which the striking value of the rays in the treatment of carcinoma can be demonstrated so conclusively as in this class of cases, for in these cases there can be no question as to diagnosis. In most instances there has been a diagnosis made by a competent surgeon and a pathologic diagnosis by a competent microscopist; and when to this are added recurrences and metastases, which in themselves are characteristic and which in most instances are entirely inoperable, their disappearance under the action of the rays, with no other agent, becomes conclusive proof, to my mind, of the great value of the roentgen rays in the treatment of deep-seated malignant disease. Fifteen cases of this class were reported in a previous paper, which was read before the Seventeenth International Medical Congress, London, August 12, 1913 (17).

In a second paper upon "Roentgentherapy in the Treatment of Deep-Seated Malignant Disease" (21), I added a few other striking cases belonging to this group, in which most remarkable results had been obtained. In this paper, for the sake of brevity, I shall refer only to the cases of *metastatic carcinoma involving bone, from carcinoma of the breast,* which I have treated.

In this group of cases, so far as I am able to learn, good results have not been obtained by any other known method, and it forms the most striking and conclusive proof of the effect of deep roentgentherapy upon malignant disease, for no malignant disease can be deeper than that involving the bone. While I am reporting some remarkable successes in the treatment of malignant disease, it must be understood that I have also had many failures, for as wi l be shown by the cases which I have reported, I undertake the treatment of many patients for whom there can be little hope. In practically all the patients there is some improvement. The patients are made more comfortable; pain is relieved; there is a diminution in the disease, and I am sure that life is prolonged. In some cases there seems to be a temporary recovery and the greatest hope of complete success is shown, and then, without known cause, a recurrence takes place which one cannot control by any form of radiotherapy. This seems to prove that the malignant cells have developed a certain resistance to the radiation, or that in some way we have, by means of this extensive radiation, reduced the resisting powers of the organism which then succumbs to the disease which develops with rapidity. In all, I have treated five cases of metastatic carcinoma to the bone following amputation

of the breast for carcinoma, and in all I am able to show the most decided evidence of a healing process.

CASE 1. Mrs. B., aged 32, came to me September 19, 1913. She has been operated on August 20, 1910, by Dr. John B. Deaver, for carcinoma of the right breast (confirmed by pathologic examination) and for recurrence, March 27, 1911. The patient said she had had in all four operations. September 19, at the beginning of my treatment, the entire operative area on the right side was studded with nodules which were firmly adherent. These extended to the axilla, and in the right axilla there were masses from one-half to three-quarters inch in diameter firmly binding the tissues. There were large nodules in the supraclavicular region of the right side. The left breast contained a mass of tumor-tissue with retraction of the nipple, with metastasis in the left axilla and in the left supraclavicular region. There were two small nodules in the scalp. About three inches of the second left rib and a small area of the third rib were destroyed and about an inch and a half of the right tenth rib, with disease of the eighth, ninth, and tenth dorsal vertebræ, the fifth lumbar, and the upper part of the sacrum. Ordinarily such an extensive distribution of disease would preclude even the thought of accomplishing any good results, but this patient had an unusual amount of determination to get well. I therefore decided to see what could be accomplished. She has received an enormous amount of treatment over the entire body during the past three years, 325 doses averaging about 20X or amounting to 6500X. As a result she has gained 20 pounds in weight. She gradually became able to look after her household duties, and is now doing all her housework. She looks and acts very much stronger. All the nodules on her right chest have disappeared, as well as those in the right axilla and the right supraclavicular region. The mass in the left breast has shriveled, and while there is considerable retraction of the nipple, the area feels like fibrous tissue and is freely movable. The metastases in the left axilla and supraclavicular region have disappeared. The disease in the second rib has healed so completely that I believe an untrained man could not find the evidence of any previous disease in the rib, nor in the dorsal vertebræ. I believe the disease in the vertebra has healed. The disease in the fifth lumbar vertebra and sacrum is at present giving the patient most of her symptoms, yet both show a most decided evidence of a healing process. The diseased area has become refilled with lime salts, and I believe from the present evidence at hand that this will probably heal completely.

In this case we are undoubtedly dealing with a general carcinomatosis, and the chances of ultimate failure are very great; but so far there has been progressive improvement, and the results have been the most remarkable of any that I have ever seen (Figs. 1, 2, 3 and 4).

CASE 2. Mrs. M., age 48, referred by Dr. John B. Deaver, October 28, 1914, had had her right breast amputated September 22, 1913. She had noticed a tumor for nine months. For five months preceding the operation she had received some roentgen-ray treatment in another city without improvement. Following the operation she received some postoperative treatment near her home. At the time she was referred to me, she had a recurrent carcinoma half the size of a hen's egg, firmly attached to the third and fourth ribs, and the interspace between them. The patient was given eight full doses of rays through eight different areas of skin, each dose of filtered rays representing 20X=160X.[1] This series was given October 28, November 18, December 14, and January 18. When the last series was given the tumor had disappeared. The patient had had in all from us four series of treatments, the last one being given as an additional precaution.

Up to the present time there has been no recurrence nor any evidence of malignant disease in the area of her chest treated, and the recurrence for which she was referred to me has entirely disappeared. The skin is healthy. All this despite the fact that there has been extensive metastasis elsewhere in the body, and this fact leads me to believe that the metastasis probably took place before the X-ray treatment was begun. On April 27, 1915, the patient consulted Dr. Deaver who again referred her to me on account of a tumor which had developed in the right side of her forehead, and which was about three-fourths inch in diameter. This was hard, firmly adherent and both Dr. Deaver and I looked upon this as metastatic carcinoma. The patient refused treatment, however, and returned three months later with symptoms of spinal involvement. At this time, the tumor was present on the forehead, and X-ray examination showed disease of the seventh, eighth, ninth, tenth, eleventh, and twelfth dorsal vertebræ, and of the tenth rib on the left side and the eleventh rib on the right side. Treatment was then directed toward the forehead and over the spinal column, and one course of treatment was given each month. September 1915 she was brought to the hospital for treatment on a stretcher. Her spine was so tender and she suffered so much pain on movement that she had to be lifted about on pillows. There did not seem to be enough strength to support her own body. X-ray examination showed, in addition to the lesions previously described, disease of the

[1] One X=a Kienboeck unit (measured by a definite shade of photographic effect on special photographic paper recommended by Kienboeck); 10X of unfiltered rays=an erythema or epilation dose; 10X=tint "B" of the special barium-platin-cyanid disks (Sabouraud and Noire); 20X can be given without producing a burn because of thorough filtration and the use of hard rays.

right shoulder-joint with destruction of the glenoid fossa and a portion of the head of the humerus with a focus of disease in the left glenoid fossa. She had evidence of carcinoma of the lung. There were nodules present in the skin of the abdomen. In other words, there seemed to be a general carcinomatosis. The patient received another course of treatment covering practically the entire body and comprising about 20 doses. This was repeated once a month until April, 1916, when she was able to walk out of the hospital, and was reasonably comfortable. She has been given one course of twenty doses in June, 1916, traveling 50 miles, and standing the trip very well. X-ray examination shows now complete healing of the right shoulder, healing of the ribs, and healing of the vertebræ. Like Case 1, there can be no assurance that this patient will ever completely recover, but with this remarkable improvement, we are surely justified in going as far as we can toward recovery (Figs. 5, 6, 7, 8, 9, 10).[1]

Case 3. Mrs. S. P., age 34, was referred to me November 5, 1915. In July, 1914, she had her right breast removed for carcinoma. One year after the first operation she consulted Dr. DeWitt on account of carcinoma in the left breast with metastasis in the axilla. This cancer was also removed. The microscopical study of these tumors showed scirrhous carcinoma. Within two months after the second operation, definite evidence of recurrence had developed in the anterior surface of the chest, involving the supraclavicular region with radiating pains in the neck, shoulders, arms, about the intercostal muscles and down the thighs. X-ray examination showed disease in the upper mediastinum, disease of the lung, disease in the head of the left humerus, the left eighth rib, partial absorption of the fifth dorsal vertebra with less evidence of disease in the other dorsal vertebræ. Also marked disease in the fifth lumbar vertebra and sacrum, with marked tenderness over both of these points. The patient was given one course of twenty-seven doses covering practically her entire body during the month of November, and another during the month of December. She was then sent to Michigan with instruction not to return, for I looked upon the case as practically hopeless. She, however, returned against my advice January 13, 1916, at which time the right arm was swollen twice its normal size, and the roentgenogram showed marked destructive disease of the head of the right humerus, the right glenoid fossa, the left lung, the left glenoid fossa, in addition to the extensive disease of the vertebræ. The patient was then given a course of treatment during the months of January, February, March, April, and May, at which time she returned to Michigan with marked general improvement. In January she was absolutely bedfast. In May she was able to stand up and probably would have been able to walk, though I was afraid to let her walk for fear of fracturing her spine. The nodules on the anterior surface of the chest had decreased in size. The swelling of the arm was reduced probably 50 per cent. The head of the humerus and glenoid fossa on both sides had nearly healed. The vertebræ and sacrum showed distinct evidence of healing. She was allowed to go home May 27, 1916.[2] (Figs. 11 and 12).

Case 4. Mrs. J. G. M., age 52, was referred to me by Dr. William F. Rink and Dr. Gustave VanLennop, April 8, 1916. In 1905 Dr. Charles Noble had amputated the right breast for carcinoma. No trouble had developed from it since. Had an operation for some ovarian condition in 1908. Three months before she was referred to me she had fallen downstairs injuring herself in the back of the neck. About a week later "neuritis" developed all through her head. By physical examination I found a swelling about the back of the neck, the head being set very low upon the shoulders, and a general stiffness, together with continuous pain. She reported herself as being more comfortable when lying down. X-ray examination showed decalcification and compression of the second, third, fourth, fifth, and sixth cervical vertebræ with evidence of disease in the first and seventh. The five cervical vertebræ had lost all their form, were almost completely decalcified, and the whole diseased area had the appearance of metastatic carcinoma. There was a mass of calcareous debris about the size of a hen's egg crowded backward between the first and second cervicals. She received a course of treatmen composed of seventeen doses given from different angles toward this diseased area, which was repeated again in three weeks. Her neck was placed in a celluloid cast so as to give it support, and she was allowed to go to her home. At the end of eight weeks, when she reported for her third course of treatment, she was free from pain, was able to go about comfortably; traveled eighteen miles, and X-ray examination showed distinct evidence of recalcification of the vertebræ.

Case 5. Mrs. M. McW., age 41, was referred to me March 6, 1915, by Dr. Stillwell Burns. Six weeks previously, Dr. Burns had amputated both breasts; one showed carcinoma and the other subnormal involution. She had returned to her home several weeks previously and while hastening upstairs, she had a fracture in the lower third of the thigh, which, upon X-ray examination, was found to be involved by metastatic carcinoma. After conference with Dr. Burns, we decided to place her thigh in a fracture box, and then treat it through the dressings by means of the roentgen rays. A month later, when examined, we found distinct evidence of callous formation and recalcification of the diseased area. No X-ray treatment had been given elsewhere in the body. At the end of six weeks she returned to her home. The fracture seemed to be united as determined physically and by X-ray examination. Soon after reaching her

[1] Case 2. This patient died since the above report was written with symptoms of hepatic involvement.

[2] Case 3. Died since the above report was written.

home she developed signs of visceral disease and died. The lower end of the femur was resected at postmortem and on June 16, 1915, another X-ray study was made of the resected bone which showed complete healing and certainly as healthy as could be expected in the average bone in a woman of this age in that period of time. It was our intention to have this bone sectioned and examined microscopically, but through the misunderstanding on the part of one of the nurses, it was thrown into the waste can and lost.

A review of these five cases of metastatic carcinoma of the bone establishes beyond the slightest doubt, the healing value of the roentgen rays in carcinoma. One who is extremely skeptical might attribute the healing in a single case to the natural resistance of the body, but when these four cases are reviewed, that argument cannot hold, and the argument of spontaneous recovery without the use of the rays cannot hold when we consider the last case in which only the femur was treated by the roentgen rays, and in which the femur recovered and the patient died of carcinoma elsewhere.

Carcinoma of the thyroid. CASE 1 was a young woman of 36, who had been operated upon three times previously for carcinoma of the thyroid, and was referred to me by Dr. John Deaver June 14, 1910, for a third recurrence. She had been operated on for carcinoma of the thyroid, July 1908, and for recurrence March 1909, and May 6, 1910. June 14, 1910, when referred to me, she again had a recurrence, and Dr. Deaver considered it unwise to operate further. Active treatment was begun, and June 30, 1911, she seemed to be free from disease. September 9, 1911, she returned with pain in her right cervical region. This pain increased, and roentgen examination, December 6, showed metastatic carcinoma in the second cervical. From this metastasis she died July 6, 1912, but there was no recurrence of the disease in the thyroid.

This was an ultimate failure, but I look on it as a brilliant temporary result, for the rapid recurrence after the third operation was completely controlled. The metastasis in the cervical spine may have taken place at any time previously — probably before my treatment.

CASE 2. Mrs. L. S., age 46, was referred by Dr. John B. Deaver, February 10, 1913. Dr. Deaver had removed a carcinoma of the thyroid two weeks previously (confirmed by microscopic examination). He was unable to remove all of the disease, and so stated when he referred the patient. She was given fifty-six full doses between February 10, 1913, and December 2, 1913, at which time she seemed to be well. There has been no recurrence of the disease since. About a year ago she was operated on for fibroma of the uterus, with hyaline degeneration, and a fibrocystic tumor of the right ovary, which was malignant. It would seem probable that this was an independent affection, and the result in the disappearance of the remaining disease which was known to be present, following the operation in the thyroid gland is another very strong argument in favor of postoperative treatment. This patient has been seen within a few months, and is, so far as anyone can tell, well today, which is over three years since she was referred for treatment with some of the malignant disease having been known to be left behind by Dr. Deaver as impossible for removal.

Carcinoma within the abdomen. For many years treatment of this group of cases has been abandoned. With the new impetus given by the development of the crossfiring method and the filtration so as to obtain more satisfactory deep results, the work was taken up anew. The cases reported, however, chiefly involve the *uterus*, and in this field some excellent results have been obtained. In general, however, we may conclude that the proper treatment for carcinoma of the uterus is surgical removal when possible, and this surgical removal should be followed as promptly as possible by thorough postoperative deep roentgentherapy. To the inoperable cases, one may offer some hope of a cure, some benefit in practically all, in lessening hæmorrhage and pain, and at least temporary improvement, by a thorough course of skillfully applied deep roentgentherapy.

Malignant disease involving the *intestines* I believe should be dealt with surgically so far as is possible, and then followed immediately by a thorough course or courses of deep roentgentherapy. To illustrate this type, I will report one case.

Mr. H. A., age 30, was referred to me for treatment April 6, 1914. He had been operated on February 4, by Dr. Babcock for carcinoma of the sigmoid, with metastasis. Ten inches of the sigmoid was resected and the neighboring glands removed. He was given thirty-four full doses of rays between April 6 and April 9. This series or this course of treatment was again repeated May 25, June 24, August 3, 1914. Since this time he has had no treatment. He has remained perfectly

well, and is working daily. Roentgen examination showed slight irregularity in the sigmoid but nothing that would suggest carcinoma.

I believe that the rays were influenital in preventing recurrence and further metastasis, and he has remained well approximately two years and a half since the operation for carcinoma of the bowel, with metastasis. This, I believe, forms a strong argument in favor of postoperative treatment.

Carcinoma of the stomach. Early in my work I treated a number of cases by the imperfect technique used, but I have never seen any good results except in one case, in which there was undoubted disappearance of the tumor. This case was reported in my previous paper (21). Recently I have treated a few more cases. There has been some improvement, but I cannot hold out much hope from my own experience in the treatment of this group.

Deep-seated sarcoma. It has been my experience that sarcoma yields very much more readily to deep roentgentherapy than does carcinoma, and my results reported in previous papers (12, 16, 22), and other cases that I might add, would confirm this view, and leads me to expect recovery in at least 50 per cent of the cases. This increased sensitiveness to the roentgen rays of sarcoma over carcinoma, as observed by myself, corresponds to the experience and microscopical studies by Clunet and Raulet-Lapointe, in which they found the sarcomas three or four times as sensitive as the carcinoma. The length of this paper will not permit any detailed reports of this group of cases, though the results obtained are very much more brilliant than those obtained in the treatment of carcinoma.

CONCLUSIONS

1. Malignant disease should be, so far as possible, completely removed surgically, or they should be destroyed by electrothermic coagulation.

2. Each operation for malignant disease should be followed by postoperative roentgen treatment. The extent and character of this postoperative treatment will depend on the location of the disease.

3. When there is an absolute necessity for delay in operation from some other cause, the patient should be treated by means of the roentgen rays, and this treatment should be especially directed toward the glandular area. This will reduce the malignancy, and I believe help to prevent metastasis.

4. Inoperable cases should always be given the benefit of the rays. Some of them will be removed and others made operable, and all will be made more comfortable, and I believe life prolonged.

5. Local recurrences yield to roentgentherapy fairly well, and some of these patients I believe can be made permanently well.

6. Metastatic carcinoma, even when it affects the bones, has been shown to heal in at least four cases.

7. A skilful combination of the best methods known in the treatment of malignant disease, will accomplish more than any single method.

8. Thorough and intelligent application of the methods known today for the treatment and removal of precancerous lesions and for the prevention of malignant disease will do more in the fight against malignant disease than all combined methods after the disease has developed.

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THE FIELD OF NEUROLOGICAL SURGERY IN A GENERAL HOSPITAL

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IN June, 1913, the department of neurological surgery was organized at the Polyclinic Hospital; this paper is merely a report of the work of this department during the past three years, June 1, 1913, to June 1, 1916; it is published to show the great need of a special department of neurological surgery in many of the large general hospitals in this country. This hospital is the first general hospital to organize such a department, maintaining both an out-patient clinic and a regular operative clinic three times a week. The patients referred to its out-patient department have been so many that the clinic is now held daily; naturally, many patients are referred to this department both in the clinic and in the hospital who cannot be benefited by any operative procedure, and are therefore referred to the neurological or medical departments.

Owing to a better understanding of the pathological processes and to an improved operative technique, the field of neurological surgery has been very much enlarged during the past ten years. Certain neurological conditions, which were formerly considered as being practically hopeless, have been so benefited and in many cases entirely cured that it is our belief that there are still other so-called "hopeless cases" which will be successfully treated. Contrary to the general opinion regarding the mortality of neurological operations, we are glad to state that the mortality has been surprisingly low. Naturally, the end-results of brain tumors are bad, as almost 80 per cent of them are malignant; an accurate diagnosis is rarely made early and, if an operation is finally advised, the impairment both mental and physical resulting from the tumor growth and its operative removal from an area difficult of access is considerable—it is rare for such patients to be able to resume their normal activities. If neurological surgery consisted chiefly of the removal of brain tumors, then it would be a most discouraging field of work; fortunately, however, the treatment of brain tumors forms but a small percentage of neurological surgery.

It should be stated that a permission for autopsy is obtained *before* operation from all of our patients in this department, both private and ward patients, so that if a patient should die following the operation, then not

only will the cause of death be ascertained, but the accuracy of the diagnosis will be determined; future patients will then obtain the benefit of such findings, and we feel that this procedure has been most helpful; otherwise, the groping-on in the dark continues.

The following is a brief summary of the work with an occasional remark:

Total number of patients admitted to out-patient department	1,222
Total number of visits to out-patient department	4,926
Total number of patients admitted to hospital beds	841
Total number of patients operated upon	509

ACUTE FRACTURES OF THE SKULL

Total admitted	226
Total died	66
Total operated upon	75
Total died after operation	21
Total died without operation	45
Total moribund on admission (no operation)	34

That is, a total mortality of 29 per cent; if, however, the "moribund" patients are eliminated then the mortality is only 16 per cent. Regarding "moribund" patients; as is common in an institution centrally located with an active emergency and ambulance service, many patients have been received that were "moribund," or have died within two hours. This was the cause of death of 34 patients in whom the diagnosis of fracture of the skull was only incidental to other injuries, such as fracture of both femora and humeri, internal injuries, crush of the chest, fractured pelvis and the like—the patients dying in shock; other cases are included in which the primary laceration of the brain has been so severe as, in itself, to cause death within three hours.

Of the non-operative deaths, 8 were due to basilar meningitis, (the diagnosis being confirmed at autopsy in 8); 3 were associated with a condition of cardionephritis; while the others died of shock from their numerous injuries.

Of the 21 deaths following operation, 12 of these disclosed such extensive cerebral lacerations that recovery could scarcely be expected; 4 were operated upon while in severe shock (poor surgical judgment); 3 deaths occurred from infection; and 2 from pneumonia.

In the first part of this series in 1913, several patients were operated upon as a forlorn hope in the belief that an operation would give them a chance to recover; we believe now it is unwise to operate upon a patient in severe shock—with a pulse over 120, and a rising temperature—even though he may show definite signs of intracranial pressure. The patient is given his best chance by treating the condition of shock first; if he cannot survive the shock, then an operation will surely not help him. In this series of 226 acute fractures of the skull, only 75 were operated upon; that is in only 33 per cent was an operation deemed advisable.

An interesting observation is the fact that two of the operative deaths occurred from infected hæmatomata, one of the face and the other of the scalp—both far distant from the decompression area. Both deaths occurred after the operative wound had healed by primary union; both were autopsied and showed a purulent meningitis localized in each case below the seat of the hæmatoma; the decompression wound and adjacent brain were firm and showed absolutely no trace of any infection. All large hæmatomata of the scalp in fractures of the skull should be incised, evacuated, and drained.

One of the operative deaths, we regret to state, died from meningitis due to an infection of the wound, and emphasizes the need of a thorough and efficient preparation of the operative field and a most strict aseptic technique as the treatment of many fractures of the skull is emergency work, and therefore the risk is greater. In another series of cases of which 236 subtemporal decompressions were performed, only 3 infections occurred; all of these cases were prepared 12 hours before operation.

The ophthalmoscopic findings, the condition of the optic discs and retinal vessels, the pulse, temperature, and blood-pressure, and above all lumbar puncture with a measurement of the pressure of the cerebrospinal fluid, are considered the best clinical evidence of the need of any operative procedure. The diagnosis of a fracture of the skull is aided by a combination of history, oozing of cerebrospinal fluid from ears, nose, or mouth, localized ecchymoses, paresis or paralysis, disturbance of the reflexes, X-ray and other clinical signs. Many more skulls are fractured than is ordinarily believed

(that is, latent fractures), and one may only too often be surprised by the extent of a fracture as shown by X-ray or disclosed by operation, which has given rise to few or no cerebral signs; this again strongly emphasizes the fact that an operative procedure is to relieve the brain injury by lessening the intracranial condition of hæmorrhage, cerebral œdema with the resulting increased intracranial pressure rather than for the fracture itself; in fact, the fracture is really the least dangerous factor, and frequently it affords an outlet to the increased intracranial pressure by allowing the blood and cerebrospinal fluid to escape so that the patient will recover without any operative procedure; the condition of severe shock should be treated first, and then, if an ophthalmoscopic examination reveals signs of increased intracranial pressure to the extent of blurring the nasal halves of the optic discs, or even more, a pulse around 60, with the cerebrospinal fluid under high pressure at lumbar puncture, an operation should be advised as being the safest procedure, not only to save the life of the patient, but to avoid the danger of post-traumatic conditions so common after fractures of the skull. A subtemporal decompression is performed upon the side of the apparent cerebral lesion and, if the intracranial pressure is extremely high, then a bilateral decompression is performed at the same time, in order to lessen the intracranial pressure still more. A right subtemporal decompression in non-localized lesions is preferred in right-handed persons to avoid the motor speech area of the left cerebral cortex. A vertical incision is used; this route and method of cranial decompression is preferred to all others, since it drains the *base* of the skull very effectually through the middle fossa, the decompression opening is covered by the thick temporal muscle so that there is no danger of hernia, and finally it exposes the right temperosphenoidal lobe which is essentially a silent area of the brain and therefore any operative damage to the underlying cortex is not serious; the middle meningeal artery so frequently injured at the time of fracture can also be observed.[1]

[1] Am. M Ass. 1916 lxvi 1536

CONCUSSION

Total number of patients admitted	80
Average stay in hospital	2½ days

These cases are treated expectantly; they usually recover very quickly.

It should be noted that 21 of these patients complained considerably and insistently of violent headache, vertigo, nausea, and vomiting. A lumbar puncture was done both as a therapeutic and diagnostic aid, and in each instance the patient was definitely relieved; five of these patients, although not knowing the moment the fluid was withdrawn, nevertheless expressed marked relief the moment the flow began. In all of these patients, the fluid was under pressure, and in six patients the tension was extreme. This increase of cerebrospinal fluid—the so-called "cerebral œdema"—we believe is due either to a hæmorrhage of the normal excretion of the cerebrospinal fluid over the cortex, or to an increased secretion of the fluid so that the subsequent accumulation of the excess fluid produced meningeal tension, and therefore the headache with the other mild signs of increased intracranial pressure. In these cases of concussion, the increased intracranial pressure was never sufficient to blur the optic discs—merely a dilatation of the retinal vessels and, in some severe cases, a blurring of the nasal margins of the discs. The regular routine treatment consisted of the following: the usual treatment for shock with coffee by rectum; icebag (helmet) to head; absolute rest and quiet in bed; morphia, if necessary; temperature and pulse every hour for six hours; light diet and daily catharsis. These patients report every two months for observation—all work being prohibited.

OLD FRACTURES OF THE SKULL

(6 MONTHS TO 16 YEARS)

Total admitted		42
Depressed fractured vault	22	
Fractured vault (not depressed)	10	
Fractured base	10	
Operated upon		32
Died (infection)		1
Oldest fracture from date of injury		16 years
Most recent fracture from date of injury		6 months
Average length of time since injury		3 years

An analysis of the chief symptoms complained of by these 42 patients is as follows:—

1. Persistent headaches	18
2. Changes in personality	5
3. Early fatigue	7
4. Jacksonian epilepsy	9
5. Paralysis or paresis	3

This group of post-traumatic cerebral conditions is the result of a definite brain injury, either primary or secondary to increased pressure, and should emphasize the danger of that too-oft diagnosis of "traumatic neurosis." It also reminds us that we are fully justified in explaining to the patient or to his relatives, in recent cases of fracture of the skull with definite signs of increased intracranial pressure, that an operation is advisable not only to save the life of the patient primarily, but also to relieve the increased intracranial pressure and thereby lessen the danger of the development of the post-traumatic conditions which in themselves may cause endless annoyance and distress.

Many of these patients had had a depressed fracture of the vault. Operative procedure is advised in every case of recent depressed fracture of the vault for we are confident that the depression itself is a serious menace. The dura in these cases is not opened unless there is abnormal tension. In 9 of the cases that showed marked intracranial pressure, a subtemporal decompression was performed just before the depressed area of the vault was removed.

Many unusual pathological conditions were exposed by operation. In one case a piece of wood (3 cm. x 1 cm.) was found imbedded in the frontal bone of a miner who had fractured his skull five years before; in another case of six months' duration a mass of hair was found in a comminuted fracture. In six cases traumatic cysts of the cortex were found, due to supracortical hæmorrhage following the injury; in one patient numerous varicosities of the dura were ligated and partially removed.

The average duration after injury was three years. In all of these patients the definite signs of increased intracranial pressure were detected by the ophthalmoscope and confirmed by a measurement of the cerebrospinal fluid at lumbar puncture. In nearly all there were localizing signs of irritation.

Naturally many patients were examined which did not show the signs of an increased intracranial pressure, and therefore an operation was not advised; that is the diagnosis was a condition of traumatic neurosis.

It is too soon to determine the permanent results of these operations, but it is long enough to measure in a rough way some of our results. The patient in whom epilepsy was the chief complaint will be discussed later in this paper. Headaches: of the 18 patients, 14 have been entirely relieved. Fatigue: of the 7 patients who were unable to work because of this distressing symptom, 5 are now back at their work. Changes in personality, probably due in many cases to a prolonged increase of the intracranial pressure, of the 5 patients examined, 2 have improved. Of the 3 patients in whom paralysis occurred, 1 has entirely recovered; the other 2 have shown little if any improvement.

All of the patients giving a definite history of injury and followed by the above symptom-complex should be thoroughly examined for evidences of an existing increased intracranial pressure; this is particularly true in cases of old depressed fractures of the vault in the hope that localizing signs may be elicited.

OBSERVATION

Total admitted	82

More than half of these cases were admitted with a diagnosis of "possible" fracture of the skull. Besides the routine physical examination, including the ophthalmoscopic findings, a lumbar puncture and X-ray were used on every doubtful case, and it is surprising the number of so-called "latent" fractures of the skull that are thus demonstrated; that is, a fracture of the skull giving no definite, cerebral signs. Naturally, these "latent" fractures are not operated upon, merely the expectant, palliative treatment. The use of the X-ray does not help in the treatment of fracture of the skull—it merely makes possible a more accurate diagnosis; no patient with definite signs of high intracranial pressure following a severe injury to the head should be allowed to wait and the operation

delayed in order that an X-ray picture can be obtained; such a picture might satisfy our curiosity as to the presence or absence of a fracture, and yet the treatment is the same whether there is a fracture or not; besides, X-ray pictures of the head especially in fractures of the base are rarely helpful. An X-ray picture is really the least important aid in the treatment of brain injuries.

FRACTURES OF THE SPINE

Total admitted	13
Operated upon	8

Only 6 of these cases were acute fractures; 4 of these made excellent recoveries, the paralysis gradually disappearing so that 2 of them can walk.

The other 7 patients were old fractures, and this again emphasizes the point that all acute fractures of the spine giving definite signs of compression of the spinal cord, and yet the vertebral dislocation is not so great as to make the severance of the spinal cord a certainty, should certainly have an exploratory laminectomy. Only too frequently a patient with an acute fracture of the spinal column shows all the signs of a complete transverse myelitis, and yet later, some motor power returns and demonstrates that there was still a number of spinal nerve tracts in continuity — merely compressed. The too often "careful and watchful waiting" policy is many times responsible for the delay that is most harmful. In cases of complete transverse myelitis due to pressure and a severance of the spinal cord, naturally nothing can be hoped for, but in many acute cases this apparent transverse myelitis is the result of a compression rather than of a primary destruction of the parts of the spinal cord at the time of the accident, and if this compression is removed shortly after the accident, the ultimate improvement will be much greater; that is, an exploratory spinal decompression is advisable in selected acute fractures of the spine in the hope that the spinal cord is merely compressed and not irreparably damaged. The dura is always left open to insure a real decompression. The operation itself is technically very simple and of comparatively little risk.

TUMORS OF THE BRAIN

Total admitted	36
Operated	31
Died in hospital after operation	6

Type of growth		Type of Operation	
Glioma	10	Osteoplastic flap	11
Sarcoma	8	Subtemporal decompression	12
Tuberculoma	4	Single decompression	5
Pituitary	3	Bilateral decompression	7
Cysts	6	Cerebellar decompression	8
Unknown	5		

This field of neurological surgery is most discouraging at the present time. The diagnosis is difficult to make early, and, with rare exceptions, the localization of the tumor is still more difficult. Besides, these tumors are usually malignant, and therefore they recur. However, the brilliant success one occasionally has in "pulling out of the fire," as it were, a hopeless case more than counterbalances the disappointment of the less fortunate cases. An earlier diagnosis will be of the greatest help.

Of the so-called fortunate cases, a few have entered this clinic. A case of pituitary tumor has been relieved and its symptoms have subsided; a large glioma removed after four recurrences has not shown any evidence of its return during the past 11 months; 3 osteosarcomata involving the frontal regions have not had a recurrence in the past two years; and 3 cysts of the cerebellum have not returned during the same time. Three patients with unlocalized cerebral tumors in which the definite signs of increased intracranial pressure were producing choked discs with visual impairment have "cleared up" with simply the operation of a bilateral subtemporal decompression. Patients should not be permitted to become blind as the results of a secondary optic atrophy due to high intracranial pressure merely because the tumors cannot be localized; an early decompression is advisable to save the vision in the hope that the tumor will later localize itself and so be removed, and yet the patient be not blind — a most discouraging condition.

ABSCESS OF THE BRAIN

Total number of patients admitted	11
Total number of operations	9
Total number of patients died	4

Eight of these cases resulted from otitic diseases; two from fractures of the skull, and

one was metastatic. The treatment of this condition has been described elsewhere.[1]

TRIFACIAL NEURALGIA

Total patients admitted		26
Patients operated upon		23
Posterior root of ganglion severed	12	
Gasserectomy	9	
Intracranial section of branches	2	
Died		0

The results obtained in this condition are most satisfactory. The genuine appreciation of the sufferers of *tic douloureux* is quite characteristic, and is well worth the added difficulty and oftentimes technically intricate and painstaking labor required to remove the ganglion, or its sensory root. The danger of this operation is slight. In each case there has been complete relief, no return of the symptoms except in two cases where the branches were merely cut intracranially owing to the poor condition of the patient.

The sectioning of the posterior sensory root of the ganglion has been the object in each operation; in 4 patients, because of a combination of excessive hæmorrhagic ooze, an unusual bony conformation rendering it technically very difficult, and, finally, the poor condition of the patient, warranted only a thorough division and maceration of the ganglion. In the majority of cases, it is not necessary to remove the zygoma in order to obtain a good exposure of the ganglion; in only 1 case was it deemed necessary, the patient weighing 200 pounds and having a very broad face. Ordinarily the presence of the zygoma does not seriously hamper the exposure of the field and it does not allow a marked deformity of depression to occur at the operative site. When alcohol injections have been used previously, not only was more hæmorrhage encountered in approaching the ganglion, but it was a much more difficult procedure, probably due to the new-formed vascular and connective tissue stimulated by the irritation of the alcohol.

PERIPHERAL NERVE ANASTOMOSIS

Total patients admitted to hospital		108
Patients operated		105
Type: Facial	8	
Brachial	81	
Others	16	

[1] Laryngoscope, 1914, Mar.

This phase of neurological surgery is particularly interesting and most encouraging. The complete dissection necessary to expose the lesion and its anatomical study combined with a definite pathological condition with its clinical variations form a fascinating field of work.

Peripheral brachial birth palsies headed the list. Eighty-one were operated upon, and of these the fifth and sixth roots were found impaired in 62; the seventh in 21; and the eighth and first dorsal roots were found damaged in 19. Naturally there were various combinations, even the entire plexus being ruptured, though rarely. The ages ranged from one month up to fifteen years. The usual lesion was a dense connective-tissue formation choking the plexus and thus impairing its function, usually of the upper arm type of brachial paralysis.

One month is the ideal time for the operation if the paralysis of the arm is complete; if not complete, then 3 months of age if a marked improvement has not occurred. In doubtful cases, an exploratory incision should be made to ascertain the condition of the plexus. The postoperative treatment holds the arm over the head by means of adhesive straps for a period of three months and then regular massage and exercises are given.[2]

In the 8 cases of facial paralysis, the distal end of the facial nerve as it emerged from the stylomastoid foramen was anastomosed to one-half of the adjacent hypoglossal nerve, care being taken to get a full dissection of both nerves, so that there should not be any tension whatsoever.

The other anastomosis included the following: 6 of the median nerve, 5 of the ulnar nerve, 2 of the musculospiral nerve, and 1 each of the anterior crural nerve and the inferior and recurrent laryngeal nerves following an injury. In this work of nerve anastomosis, it is absolutely essential to resect and pare the nerve-ends free of all scar tissue; otherwise a return of nerve function will not be possible because the delicate nerve-fibers will be unable to grow down through this scar-tissue formation, the cause of many bad results in peripheral nerve anastomosis.

[2] J. Am. M. Ass., 1916, lxvi, 876.

HYDROCEPHALUS

Total number of patients admitted	28
External hydrocephalus	19
Internal hydrocephalus	9
Total number of patients operated upon	27
Single decompression and drainage	8
Double decompression and drainage	19
Total number of patients died	8

In this group of cases a new method of intraventricular and subdural drainage through the subtemporal route has been instituted. These cases apparently so hopeless from both a surgical and medical standpoint are now particularly inviting in their appeal for relief especially in view of the experimental work now being conducted. Concerning the method of drainage just mentioned, a full report will be given in the near future. Although sufficient time has not elapsed to warrant stating that the condition in the patients has been permanently overcome, nevertheless, in 14 cases the improvement has been marked, and 5 patients who were formerly unable to move their heads from the pillow are now walking. Regarding the 8 deaths in this series of 27 patients operated upon, 2 died of pneumonia two and six days respectively after being discharged from the hospital and more than two weeks after the operation.

The great frequency of external hydrocephalus as compared with the internal type has been very surprising; in each case the ventricles were punctured and, in 19 of the 28 patients, the ventricles were found not to be dilated; that is, we were dealing with the external type of hydrocephalus with no blockage of the ventricles.

SPINA BIFIDA

Total patients admitted	12
Total patients operated upon	11
Total patients died	3

Eleven cases of spina bifida were operated upon. In 5 of them there was an associated hydrocephalus which was drained as described above; 3 of the cases died—1 of them from pneumonia on the twenty-second day postoperative. Four of these cases have improved markedly though it is still too early to comment upon the end-results. We believe that spina bifida is due to the same causes producing hydrocephalus; that is, a blockage of the excretion of the cerebrospinal fluid; thus an increased intracranial pressure results producing a protrusion of the spinal canal in the region which closes the latest that is in the lumbar area. If the pressure is very high then a hydrocephalus may also occur. If the increased intracranial pressure occurs after the complete closure of the spinal canal then a spina bifida does not occur, only the hydrocephalus. That is spina bifida is not a defect but rather the result of increased intracranial pressure.

CEREBRAL SPASTIC PARALYSIS

Total number of patients examined		1,026
Hemiplegia	117	
Paraplegia	38	
Diplegia	80	
Patients admitted		531
Patients operated upon		236
Single decompression	187	
Bilateral decompression	49	
Patients died		20
Mortality percentage		8

Special work has been done in this department upon selected cases of spastic paralysis. Only selected cases of true cerebral spastic paralysis due to birth traumatism with its resulting cortical hæmorrhage and showing definite signs of an existing increased intracranial pressure by ophthalmoscopic examination and confirmed by the measurement of the pressure of the cerebrospinal fluid at lumbar puncture are considered. Cases of Little's disease due to agenesis of the cortex, malformations and lack of development of the brain and its pyramidal tracts and conditions of spasticity due to the various forms of meningitis are easily excluded by a careful history, ophthalmoscopic examination and lumbar puncture; obviously, these latter cases do not and cannot show signs of an increased intracranial pressure so that any cranial operative procedure for them would be but a needless risk and could in no possible manner benefit the condition.

A single or double subtemporal decompression is performed in the attempt to relieve the existing increased intracranial pressure of the hæmorrhagic, cyst-like formation on the cerebral cortex—the remains of the primary, supracortical hæmorrhage; that is, the cerebral impairment is secondary to

the pressure of the hæmorrhage and not due to a primary destruction of nerve-cells, as formerly believed.

In this series of 1,026 examined patients, 236 were operated upon, that is, about 1 out of every 4 patients examined showed definite signs of increased intracranial pressure and were therefore the selected cases that could be benefited by a lessening of this intracranial pressure; the usual age of the children has been between 2 and 6 years; naturally the younger the child, the greater chance there is for improvement. A number of observations regarding the pre-operative and postoperative care of children with this complaint will soon be published.[1]

The results in these selected cases of spastic paralysis have been very satisfactory both physically and mentally, and in only 13 patients has there been no improvement. Of the 20 patients who died after the operation, 9 of them were under two years of age and of the extreme diplegic type being very poor operative risks owing to their emaciation and great difficulty of swallowing.

EPILEPSY (THE CHIEF COMPLAINT)

Total number of patients admitted	190
Etiology—	
Meningo-encephalitis	41
Old fracture of skull	9
Spastic birth palsy	106
Tumor of brain	8
Unknown	26
Included elsewhere	123

The condition of epilepsy is at present such a hopeless condition that its surgical aspect is considered very frequently in the hope that something can be done to lessen the severity and frequency of the attacks at least; it was thought best to include a separate series of all cases admitted to the service with epilepsy as the most prominent symptoms.

All of these patients operated upon were selected ones who showed distinct evidences of increased intracranial pressure and in whom thorough medical treatment had been used and had failed to improve the condition.

[1] N. Y. St. J. Med., 1916, Oct.

The type following an old encephalitis of childhood was very interesting, and its pathological picture of thickened vascular dura, thickened pia-arachnoid network of new-formed tissue and vascular trees superimposed on the cortex, smoky induration of cerebral vessels, was very marked; 10 of these children were operated upon; in only 2 of them had the convulsions apparently been permanently improved.

Besides the cases of spastic paralysis, the most encouraging results have been in the old fractures of the skull, in whom 5 of the total of 9 cases the epilepsy has apparently disappeared.

Attention is again called to the point that the cases operated upon are selected ones only—according to the presence of a marked increased intracranial pressure and with definite localizing signs. The operative effort is to relieve that pressure, and possibly change or modify the cerebral vascular equilibrium. Routine operative treatment in the usual cases of epilepsy is of course condemned. In the majority of these patients, the Jacksonian type of epilepsy of a localized lesion has been prominent.

APOPLEXY

Total patients admitted	12

Cases were referred to this department in the hope that the hæmorrhage might be of ventricular type or of the supracortical type in which operative interference by drainage is indicated. However, none of the patients at this hospital were of this type and therefore were not operated upon.

Besides the above cases, there were ones due to thrombosis of the cavernous sinus, nerve compression due to a cervical rib, tumors of the spinal cord, and then a number of patients whose condition we could not satisfactorily diagnose. The assistance of Dr. C. S. Hunt as anæsthetist and of Drs. H. B. Dunham and Y. C. Lott has made it possible for this work to be performed.

HÆMATOCOLPOS, HÆMATOMETRA, AND HÆMATOSALPINX IN A WOMAN OF SEVENTY-FOUR YEARS

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IN the case to be recorded in the following, a condition of absorbing interest and extreme rarity revealed itself.

The patient was 74 years of age. She had never been pregnant. Her menstruations had always been normal until about 35 years ago when she entered the climacterium. She had had no vaginal discharge of any kind since then. At the age of 67, she was operated upon for cystocele. Dr. W. V. Laws, of Hot Springs, Arkansas, who performed an anterior colporrhaphy, informed me that the senile atrophy of the uterus was quite noticeable at the time. There ensued a period of almost seven years of good health until two and a half months ago when she complained of painful sensations which originated in the lumbar regions and extended into the groins and toward the bladder. This pain, which occurred in the form of attacks, had at first the character of a dull ache, but had gradually become more severe, particularly in the region of the bladder where it assumed paroxysmal proportions. The attacks increased in frequency and for the last week or two occurred daily. Position of the patient or exertions seemed to have no bearing on their occurrence. There was a peculiar regularity about these attacks in that they appeared only between two and six in the afternoon. At other times, the patient was free from pain but she had a constant bearing down which prevented her from standing straight. Urination was distinctly affected. The output of urine was scanty and ceased altogether during the attacks. Toward evening she voided a larger quantity of urine either with a good deal of straining or, on the contrary, involuntarily, and this seemed to terminate the attacks. The urine was never bloody.

As these symptoms pointed to an obstruction in the bladder, Dr. Walter Fischel, who had observed the patient for a few days, referred her to me for cystoscopic examination on February 22, 1916. The urine was clear; the quality normal. The cystoscope, on its passage through the urethra, encountered an obstacle and had to be introduced steeply upward. The capacity of the bladder was normal. The appearance of the vesical mucosa was also normal with the exception of large, pulsating vessels. There was a tumor in the vesicovaginal septum which pushed the bladder wall forward. The ureteral openings were on the top of the eminence.

Gynecologic examination showed the following: Vulva and vagina were senile. The finger was arrested, about three-fourths inch above the entrance, by a round tumor behind the anterior vaginal wall. Its relation to the cervix could not be ascertained because of a constriction which did not even permit the tip of the index finger to pass. The anus was wide open, and by rectovaginal examination a smooth, firm tumor, about the size and shape of an ostrich egg, which filled the entire pelvic cavity, could be felt. The upper pole could not be mapped out through the adipose abdominal walls, and the marked tenderness forbade more accurate exploration.

A tentative diagnosis of cervical fibroid was made, although the absence of bleeding rendered this assumption highly doubtful. At any rate, there was a vital indication for operation as the intense pain and the evident obstruction to urination made surgical intervention imperative despite the advanced age of the patient. Accordingly, operation was performed February 25, 1916. In spinal anæsthesia, which took effect within ten minutes after the injection, the abdomen was opened in the median line by an incision from the symphysis to within two fingers' breadth of the umbilicus. There were no adhesions or fluid in the peritoneal cavity. The intestines and omentum rested upon the upper pole of a tumor which extended above the promontory. With the patient in deep Trendelenburg position and the intestines pushed out of the way, the tumor was exposed to view and seen to rise from the pelvic cavity. It was the enlarged and fluctuating body of the uterus which was in continuity with a very much larger and markedly fluctuating cervix. The round ligaments inserted at their normal places. The left tube, adherent to the uterus, represented a tortuous hæmatosalpinx; the left ovary was atrophic. The right tube was also adherent and distended, though to a lesser degree; the right ovary, probably atrophic, could not be identified. The fundus and upper portion of the rectum were kept in apposition by a broad and thick sheet of adhesions which was clamped and severed.

The diagnosis of hæmatometra had by now become obvious, and panhysterectomy was carried out in the usual fashion with preventive ligation of all arteries. Volsella were not used in order not to tear into the uterine cavity. After the round and infundibulopelvic ligaments on either side had been cut, a flap of peritoneum was dissected off from the posterior aspect of the cervical tumor. The bladder was pushed off from the anterior surface almost down to the urethra and also laterally. The overstretched, cord-like uterine arteries could be plainly seen and were ligated separately. It was now an easy matter to free the lower portion of the tumor by

finger dissection and to shell the entire tumor out of its bed in the depth of the pelvis. The remarkable part was this that the entire tumor could thus be lifted out and removed without having to cut into the vagina. In other words, there was only a layer of loose connective tissue between the lower pole of the tumor and the vagina. It was quite plain that the wound cavity did not open into the vagina. The wound cavity was perfectly dry and could easily be peritonealized. There was nothing else of interest in the lower abdominal cavity except a number of greyish spots in the wall of the sigmoid The abdomen was closed in layers.

Spinal anæsthesia had been perfect in every respect. The pulse had not varied in frequency at all but had become a little weaker in volume; therefore, strychnine was injected twice, merely as a matter of precaution.

The patient recuperated amazingly well from the operation. At no time were anodynes or stimulants needed. Temperature, pulse, and respiration remained normal throughout, and the abdominal wound healed by primary union. To forestall hypostatic pneumonia, the patient was raised in bed soon after operation and encouraged to turn freely from side to side. Digitalis was given prophylactically., She sat in a chair on the twelfth day after operation and walked about the room on the fourteenth. On the evening of this day the pulse suddenly rose to 118, the respiration to 30. She slept well; the pulse dropped to 104 the next morning, but the respiration was still 30. While eating her breakfast, propped up in bed, she suddenly sank back and died without any premonitory symptoms. An embolism had terminated her life.

The specimen represents a tumor 17½ centimeters in length with a width of 8½ centimeters of the upper and 10½ centimeters of the lower portion (Fig. 1). Its configuration is plainly that of a uterus of exaggerated dimensions. The posterior aspect, which is shown in the picture, indicates the position of the internal os by a waist-like indention. Below the latter, the edge of peritoneal cover shows the site where the flap was dissected off during the operation. On the right side the trunk of the uterine artery, where it runs along the edge of the uterus, can be seen. The distention of the tubes, particularly on the left side, is plain.

The tumor was quite evidently a hæmatometra, and the question suggested itself at once: What agency had caused the bleeding in so old a woman? Further investigation was, however, deferred until the specimen has been hardened sufficiently in Kaiserling's solution. It was then opened by a median incision and the remarkable findings were observed which appear in Fig. 2. The tumor consists of two parts, a larger lower and a smaller upper one. These are separated from one another by a thick bridge of fibrous tissue which has but a small central opening; the latter, of course, is the internal os. The walls of the upper portion, the uterine cavity, are 5 millimeters thick, those of the lower portion are thinner the further down we go and have only the thicknesss of paper at the lower pole. Both cavities are filled with blood which coagulated during the hardening process as there was marked fluctuation present in the fresh specimen. The umbilicus-like retraction at the lower pole, which was not present in the fresh state, is obviously due to contraction of the coagulum. A solid sessile growth rises from the posterior wall into the uterine cavity. Smaller excrescences occupy the uppermost part of the fundus, while another growth is connected with the wall by a slender stem and ramifying into many delicate finger-like processes extends far into the cavity. Within the wall of the uterine cavity just above the internal os, a small oblong tumor is seen in section, distinguished by its whiter color from the surrounding tissue. Microscopic examination made by Dr. E. L. Opie, Professor of Pathology, Washington University Medical School, showed that the small tumor in the wall of the uterus was a fibroid, while the tumors springing from the inside of the uterine cavity were adenocarcinomatous. It is interesting to see in these microscopic sections that the carcinoma is of the everting type and that the cancer-cells nowhere penetrate into the fibromuscular wall of the uterus.

The source of the blood which filled and distended the uterus was thus established. The next question naturally was: What produced the obstruction which prevented the escape of the blood and thus led to the formation of hæmatometra?, and further: At what point of the genital tract was the atresia located?

To determine these questions it will be necessary to consult the literature on hæmatometra in the aged. This is quickly enough done; for whereas the literature on retention of menstrual blood is rather voluminous, hæmatometra is extremely rare in women past the menopause. In younger years, the atresia may be either congenital (imperforate hymen, anomaly of the vagina, etc.) or, more frequently, acquired (vaginitis in diseases of childhood, injuries at parturition, puerperal infections, excessive cauterization of the cervix, etc.). In advanced years, with a history of previous menstruations or childbirth, atresia can only be of acquired origin.

Verdier, in 1906, presented a personal observation and thirteen cases from the French and Russian literature, of women, ranging in age from 46 to 63, in whom a malignant new-growth situated in the uterine cavity near the internal os had obstructed the escape of blood from the overdistended uterus. In the case reported by Foges, that of a woman of 60 whose menses had ceased 10 years previously, the cervix was fairly normal and the external orifice

Fig. 1. Posterior aspect of the tumor. A waist-like indentation indicates the border between cervix and body of the uterus. Note the course of the uterine artery on the right and the distention of both tubes.

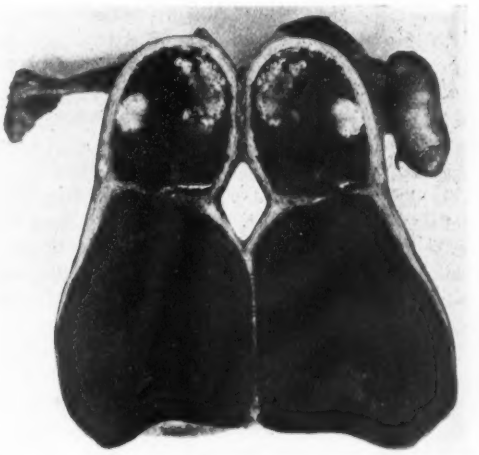

Fig. 2. Tumor opened by median incision. The upper and smaller portion is the uterine cavity, the lower and larger one represents the cervical canal and the distended vagina. The two parts are separated by a thick bridge of fibrous tissue in which a small central opening indicates the internal os. The entire tumor is filled with blood. Note the development of adenocarcinomatous masses in the uterine cavity.

admitted the tip of the index finger, while the uterine body formed a movable, round, smooth, and fluctuating tumor of the size of a man's fist. On operation, 60 cubic centimeters of blood was drained from the uterine cavity. The source of the blood and the cause of obstruction was a carcinoma within the cervical canal 2½ centimeters above the external os and extending upward to the internal orifice. That cancer of the cervical canal may obstruct the passage and lead to retention of fluid in the uterine cavity is well known to every gynecologist. In almost all such cases, however, the result is a pyometra. To cite but one of the many cases reported, Hansemann found at autopsy in a woman of 72 the uterine body transformed into a thin-walled sac the size of a child's head, which was filled with pus; the cause of the occlusion was a beginning cancer in the cervical canal. It is more than likely that in such cases of pyometra the contents of the uterine cavity had at first been sanguinolent and only secondarily become purulent by the invasion of bacteria from the necrotic new-growth. In Chrobak's case, a woman of 55, whose menopause dated 8 years back, presented herself with a carcinoma of the vaginal portion which was thoroughly excochleated and cauterized with pure nitric acid. This cauterization caused atresia which in its turn led, within 3½ years, to the formation of hydrometra. The uterus corresponded in size to one of four months' pregnancy, and on puncture 350 cubic centimeters of a yellowish-greenish, cloudy, alkaline fluid with a specific gravity of 1026 were drained. Microscopically, the fluid contained red blood-corpuscles, epithelial cells, and cholesterin crystals. Five months later, an even larger hydrometra had formed.

In Frank's observation of postclimacteric hæmatometra the etiology of atresia was likewise due to excessive cauterization. A woman of 49 had been subjected to some form of intra-uterine treatment ten years previously. Menses had ceased since then. Menstrual molimina occurred until one year ago and again for the last six months. On laparotomy, there was a hæmatosalpinx on the left side, the size of a fist; the uterine body was enlarged and contained dark, liquid blood. Lichtenstein's patient was a woman of 51 in whom menopause had occurred ½ year ago. Pelvis and lower abdomen were occupied by a smooth cystic tumor extending almost to the umbilicus. The vaginal portion was not discernible. A very small, reddened, round area in the roof of the vagina indicated the site of the external os. A sound forced through at this point entered into a large cavity from which 500 cubic centimeters of dark, thick, partly clotted blood escaped. The atresia in this case was due to senile conglutination of the external orifice.

While these two observations, strictly speaking, do not belong to the category of postclimacteric hæmatometra, the last named case leads us to the most frequent cause of

gynatresia in advanced age; namely, senile adhesive processes in the genital tract. The familiar prototype of these affections, the so-called senile vaginitis, is a misnomer. There is no inflammation at work as the term would indicate. The multiple squamous epithelium of the vagina becomes thinner in old age, even as the epidermis does. The superficial layers become hornified and are cast off, and the basal layer loses to a large extent its reproductive faculty. The connective-tissue papillæ with their central blood-vessels now become visible through the thinned, transparent mucosa and even bared in places. Hence the dot-like reddening of the vagina. A thin, colorless, sticky, and acrid fluid often with traces of blood exudes from the exposed capillaries. Neighboring parts of the vagina are thus rendered raw and may easily conglutinate. Moreover, age changes take place in the elastic tissue of the vaginal wall. The delicate, wavy elastic fibers which are present in large quantities in the vaginal wall, become thick, straight, unyielding, broken off in places. Thereby more or less complete annular constrictions occur in the wall, the lumen of the vaginal tube is narrowed, opposing parts are brought into constant apposition and readily conglutinate to one another. These connections may in course of time become very firm and constitute dense bridges, bands, or membranes which eventually may completely occlude the vagina as anybody has noticed who has had occasion to examine very old women. Veit has emphasized that the favorite site for this chronic adhesive vaginitis is the border between the middle and upper third of the vagina, because the levator muscles are attached to the vagina at this point and narrow the vagina even more by their contractions. In the upper third of the vagina, the vaginal portion is too bulky and prevents apposition of the mucous surfaces, while in the lower third, the secretions, as a rule, are too copious to permit an undisturbed coalescence.

Though these conglutinations are quite common, if not physiological, yet they hardly ever cause any disturbances, because the parts above the atresia remain in a state of senile inactivity. Only very exceptionally has an accumulation of fluid been found above the occlusion, as in Veit's two cases of hæmatocolpos in one of which a cervical polypus was the source of the bleeding.

In a case of hæmatometra in a woman of 70, Féré found at autopsy a senile atresia in the vagina, while the blood retained in the uterine cavity seemed to have owed its origin to a severe mitral lesion. In the hæmatometra observed by Gradischnigg in a woman of 83, the source of bleeding is not stated; nor does Savidge offer any explanation as to the origin of bleeding in his case of hæmatometra in a woman of 65.

The observation recorded by Stein furnishes more complete data. In a woman of 66, whose menopause dated 20 years back, the uterine body, at operation, was found transformed into a thin-walled sac containing about 500 cubic centimeters of chocolate-colored blood. The walls of this sac were normal, but the cervix was the site of an adenocarcinoma. The author assumes that this had caused hæmorrhages which the senile shrinking and atresia of the cervix had prevented from escaping.

Even more instructive is the case reported by Sondheimer concerning a woman of 67 who had had one confinement thirty years previously and had been in the menopause for about seventeen years. She had noticed a "hardening in the lower abdomen" for about six weeks, associated, of late, with slight pain. Abdominal palpation revealed a fluctuating tumor which corresponded in size and shape to a pregnant uterus of five to six months. Just above the symphysis the tumor showed a sort of constriction but seemed to broaden out in the pelvic cavity. Vaginal examination was impossible because of a complete atresia at the vaginal entrance. By rectal examination, the upper half of the pelvic cavity was filled with a fluctuating tumor, obviously the continuation of the mass felt above. Differential diagnosis was between an ovarian or renal cyst and a hydro- or hæmatometra. In narcosis, an attempt was made to remove the atresia. The vaginal walls could be pushed apart by the finger for a distance of about three centimeters. As the density of the conglutination prevented further progress, puncture was made by which a cloudy, brownish-red, thin fluid was obtained, which contained fresh and degenerated erythrocytes, degenerated leucocytes, and other fatty detritus, and many large, oval, round, and cylindrical cells with large, glistening nuclei and fatty protoplasm. Laparotomy was done a few days later. The tumor was found to be the enlarged and distended uterus. Both adnexa were enveloped in old adhesions. On puncture of the uterus a fluid, similar to that obtained through the vagina, escaped. The uterus was opened and more than three quarts of fluid were emptied. Numerous small and larger particles of a medullary substance were mixed in the fluid. The inner surface of the uterine cavity was covered with soft tumor masses, the largest being of the size of a hen's

egg. The finger could be passed downward through a rigid isthmus several centimeters in length into a wide cavity filled with the same bloody fluid and loose tumor particles. The isthmus was the cervix, the cavity below the distended vagina. The only metastasis was a nodule of the size of a hazelnut in the right tube near the uterus. The uterus was amputated, but the patient died ten days after the operation. Microscopic examination revealed adenocarcinoma which had not yet invaded the myometrium.

There are several interesting parallels between Sondheimer's case and mine. Both patients were aged women of 67 and 74 years respectively. In both, the vagina was occluded by senile atresia keeping the blood dammed up, which in both instances originated from an adenocarcinoma of the body of the uterus. The new-growth, in both cases, projected into the uterine cavity but did not invade the myometrium. The only visible metastasis in Sondheimer's case was in the tube; in my own case the greyish spots in the sigmoid, noted during the operation though not suspected at the time, very likely represent a metastasis.

Aside from these points of similarity, the present observation shows a much greater intensity of the hydrostatic pressure on the part of the accumulated blood. In Sondheimer's case the fluid dilated the most easily yielding portions of the genital tract, the uterine cavity and the vagina, while the rigid cervix resisted distention. In my case, the cervix as such had ceased to exist. Only the fibrous ring of the internal os had preserved its integrity (Fig. 2). Below it, the cervical canal blended with the distended vagina and formed one large cavity in which only the increasing thinness of the walls may give an indication of the old landmarks.

The vaginal atresia had, in the course of years, become so thoroughly organized as to form a solid floor which was separated from the closed roof of the vagina by loose connective tissue. This explains the ease with which the tumor could be shelled out without the severance of any connection with the vagina. The study of the literature collected above proves this observation to be unique.

At some time during the process, blood was dammed back into the tubes which quickly became sealed at their outer ends. The formation of hæmatosalpinx in this case is an additional proof of the contention of some writers (Frankl) that occlusion of the tube need not always be the result of inflammation.

It is impossible to say how long the cancer has existed in this case. The size of the tumor masses and the absence of myometrial involvement permit the assumption that the growth was still in a fairly early stage. Mechanical pressure of the collected blood had not interfered with the development of the tumor. Incidentally, the amount of bleeding from a cancer of the uterine body is well shown in this case.

A word about the operative technique may not be amiss. Thanks to the spinal anæsthesia employed, the immediate risk of an operation of such magnitude in a very old patient was greatly reduced. In the removal of the large tumor, the usual technique of hysterectomy by means of clamping and cutting the parametria would have been impossible without injury to the ureters. The writer has for years been in the habit in his hysterectomies of ligating the uterine arteries separately before severing the parametria, and the successful performance of the operation in the present case is directly attributable to this technique. Convalescence was ideal in every respect, and there was every reason to anticipate a permanent success. No clinical symptoms indicated a thrombosis of the pelvic veins, and the fatal embolism which occurred 15 days after the hysterectomy must be considered as one of those unavoidable accidents which at times mar our most successful operations.

SUMMARY

In a woman of 74 who had menstruated normally until 35 years previously, severe pain, pointing to obstruction of the urinary flow, led to the detection of a large fluctuating tumor which filled the entire pelvis and extended upward almost to the umbilicus. The vagina was occluded by senile atresia. Laparotomy in spinal anæsthesia revealed the tumor to be an enormous hæmatometra and hæmatocolpos with bilateral hæmato-

salpinx. Panhysterectomy was performed successfully, and the tumor which was connected with the vagina only by loose connective tissue was removed unopened out of its bed. Convalescence was undisturbed; the patient left the bed on the twelfth day after operation but succumbed to an embolism on the fifteenth day. The cause of bleeding into the occluded genital tract was an adenocarcinoma of the body of the uterus.

Accumulation and retention of blood in the genitals of women past the menopause is very rare, and the few reports existing in literature are reviewed in the foregoing. Only one case has been recorded which is similar to the one presented above. Considering, however, the extreme old age of the patient, the extent of retention of blood, the anatomic condition of the lower pole of the tumor, and the modus operandi, the present observation occupies a unique position in literature.

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A STUDY OF THE ANATOMY, PATHOLOGY, AND TREATMENT OF UTERINE PROLAPSE, RECTOCELE, AND CYSTOCELE

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1. INTRODUCTORY

FOR many years the writer has been puzzled by two questions arising in connection with vaginal plastic work. The first is, why, even in the most skillful hands, are the results of repair so uneven? The second, why is it impossible to teach the average house surgeon the principles of plastic repair during his term of service, although it is easy to inculcate the technique of other type operations, such as herniotomy, hysterectomy, etc.?

The present paper was written in the hope of helping to answer these two queries satisfactorily; in other words, to assist in obtaining more uniform results on the one hand, and of describing a simple anatomic basis for operative work on the other.

The successful treatment of the varied conditions arising in plastic surgery requires first, the proper selection of the operative procedures, second, a technique sufficiently elastic to be applicable to quite diverse anatomical changes; otherwise, the demands made upon the judgment and skill of the operator become so great that this proficiency can be acquired only after many years of practice and at the expense of many and repeated failures.

The writer has seen individual operators who, through long years of experience or by reason of special gifts and dexterity, have acquired the necessary skill, but who were quite unable to teach to the spectator, or even transmit to their regular assistants the method by which they obtained their good results. This inability to teach is due to the fact that these operators, although by nicety of judgment, by precision of execution, by unconscious visualizing of reconstruction, and by proper extent of denudation they obtained good results, did not expose the field anatomically and did not perform an anatomical repair, such as is done as a matter of course in inguinal herniotomy, for example.

During the past few years concerted efforts

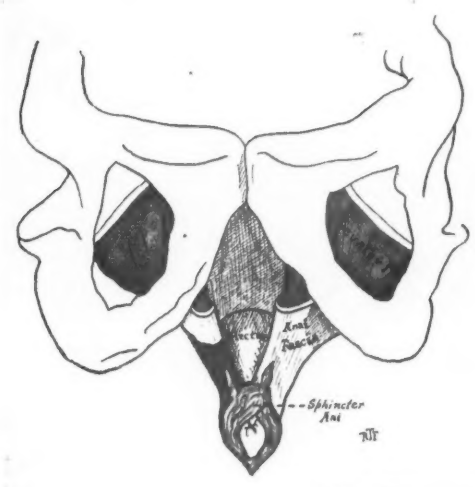


Fig. 1. Nulliparous outlet, showing the two levatores ani approaching toward the rectum, the levator gap, the rounded edge of each muscle, and the fascial junction. The lower or outer fascia is called anal fascia, the inner fascia (only its edge is seen) is known as the levator fascia. The external sphincter ani appears.

NOTE. Figs. 1 to 9 inclusive were drawn from clay models fashioned from sketches of dissections on the cadaver. The dissociable models very graphically illustrate the anatomy of the perineal region and of prolapse.

Fig. 2. The triangular ligament has been inserted between the pubic rami. The ligament is pierced by urethra and vagina. Below, it affords attachment to the sphincter.

have been made to devise a true anatomical repair in perineal lacerations by suture of the levator ani. The range of applicability and the merits and demerits of this operation will be discussed in succeeding paragraphs.

For a number of years, also, the so-called "interposition" operation has been employed in the treatment of cystocele. This procedure is anatomical in so far as its execution is concerned, but the resulting repair distorts natural conditions to a degree which necessitates sterilization, if performed in the child-bearing period. The writer considers the operation unsatisfactory when applied to cases of prolapse.

With these exceptions, the majority of operations devised for cystocele and rectocele depend upon ingenious denudations, complicated application of sutures, etc., rather than upon a firm anatomical basis.

The object of this paper is to formulate methods for the repair of cystocele and rectocele, applicable to varied conditions, and giving more uniform results in the hands of operators of only average skill and experi-

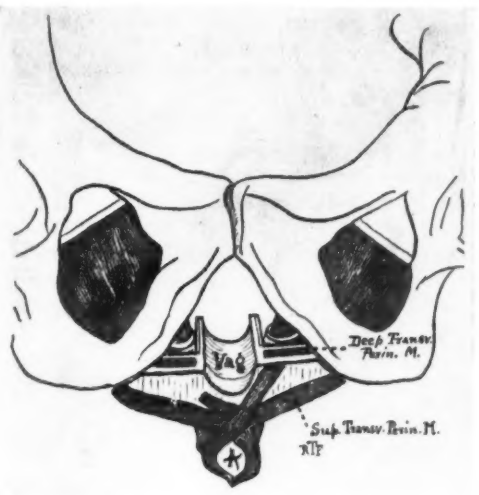


Fig. 3. The triangular ligament has been cut across the dotted line shown in Fig. 2 in order to demonstrate the junction of five fascial planes. From without inward — superficial layer of triangular ligament, deep transverse perineus muscle, deep layer of triangular ligament, junction of anal and levator ani fascia (rounded edge), fascia vaginæ propria. The muscles superficial to the triangular ligament are also shown — superficial transverse perineus, constrictor cunni.

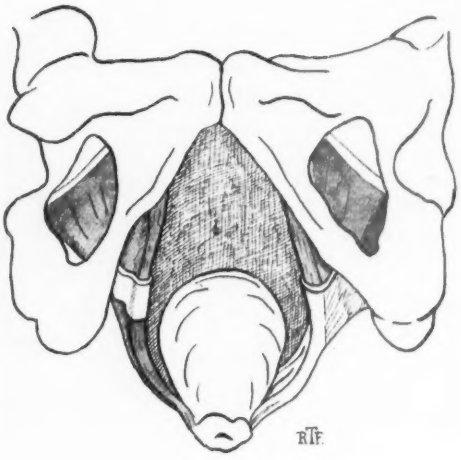


Fig. 4. Multiparous outlet. The wide levator gap due to stretching and tearing of the levator muscles and fasciæ is shown, also the bulging rectum (tear of fascia recti propria).

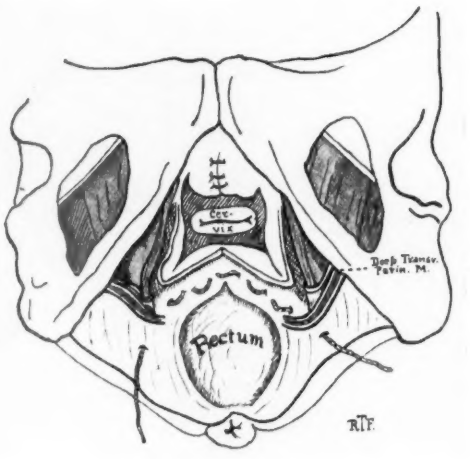


Fig. 5. The stretched triangular ligament is shown with a median tear through which the rectum bulges. A deep suture has been passed taking in the five fasciæ illustrated in Fig. 3. The cervix and deeper part of the vagina is indicated.

ence. This implies knowledge of the regional anatomy and standardization of technique, rather than the invention of new procedures.

The experience upon which the observations to be detailed are mainly based was acquired in the wards of Mt. Sinai Hospital during the past ten years. The writer takes pleasure in acknowledging his obligation to Dr. Joseph Brettauer, the head of the first gynecological service, both for inducting him into the mysteries of plastic surgery and for the use of the material. During these 10 years more than 850 plastic operations were performed by the attending and house staff, but only in the past few years has the writer personally felt a fair degree of confidence in his method of repair. This greater uniformity of results depends not upon a gradually acquired increase in proficiency, but rather upon successful standardization of successive steps, based upon anatomical foundation, so that today the method of repair is applicable to greatly varied conditions. It is with the hope that at least some of this laboriously acquired experience can be handed down to colleagues who have had less opportunity in perfecting themselves in this important branch of gynecology that this paper is written. Acknowledgment is also due to Professor Huntington of the College of Physicians and Surgeons for his kindness in supplying anatomical material.

2. Anatomy

Much has been written about the anatomy of prolapse and of the mechanism which keeps the uterus in place. The essential facts, few and readily understood, have too frequently been obscured by complicated description and ponderous classifications.

The bony pelvis is defective. It is converted into a bowl-shaped cavity by ligaments, muscles, and fasciæ.

(a) Lower or Supporting Apparatus

A thin muscle sheet, the levator ani and coccygeus, covered upon their upper and lower surfaces by fasciæ, form the true pelvic diaphragm. Anteriorly, in the region of the pubic arch, the diaphragm is defective, as the two levators do not approach to within 3 to 4 centimeters of each other (Fig. 1).

The resulting long but narrow gap is partly closed by the accessory pelvic diaphragm or

Fig. 6. Anterior and lateral view of muscles and fasciæ. The relation of the sphincter ani to triangular ligament and coccyx are shown. The various parts of the levator muscle appear — pubococcygeal sling; between it and the sphincter are shown the puborectal portion, and running transversely to the pubococcygeal fibers, the ischial part can be distinguished.

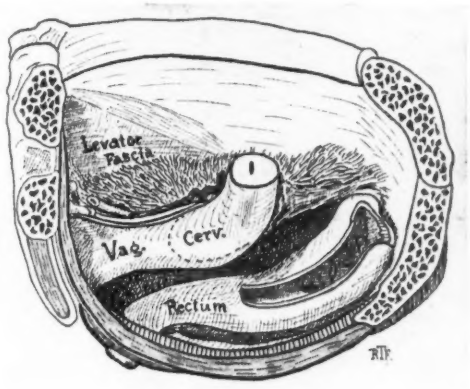


Fig. 7. Extramedian sagittal section through the pelvis, passing to left of the cervical canal. From before backward and above downward appear descending ramus of pubis, ascending ramus of ischium, and triangular ligament, all in cross section; next the pubococcygeal fibers of the levator ani, the sphincter of the anus, and the ischial portion of the levator. In the pelvis are shown the iliopectineal line, iliac fascia, white line, levator ani fascia; pelvic connective tissue, uterine artery and ureter, pubocervical fascia, vagina and cervix, perineal body, rectum (partly cut open); posteriorly, sacrum cut across. In front of the cut ureter is seen the urethra (bladder has been removed).

triangular ligament, a thin but strong structure composed of two fascial layers enclosing the deep transversus perinei muscle. The triangular ligament ends about midway between fourchette and anus in the center of the perineal body (Fig 2).

1. The *levator ani* on each side of the pelvis arises from the posterior surface of the pubic bone, and from the fascia covering the obturator internus, as far back as the spine of the ischium. Some of the pubic fibers sweep alongside the lateral vaginal wall and insert into the anterior and lateral rectal wall, mingling with the sphincter ani — puborectal fibers (Figs. 6 and 7). Other fibers, taking a more lateral course, insert on the apex and sides of the coccyx — pubococcygeal (Fig. 7). The remaining fibers arising from the obturator fascia and ischium insert in a median raphe behind the rectum, extending to the apex of the coccyx (Fig. 6).

2. Fasciæ of the levator ani. The superior or pelvic surface of the levator ani is covered by a thin, firm fascia (*levator ani fascia*) continuous posteriorly with the fascia covering the coccygeus and pyramidalis, above with the iliac fascia (Figs. 7 and 8).

The lower (perineal) surface of the levator ani is covered by the anal fascia which bounds the mesial aspect of the ischiorectal fossa (Fig. 1).

Along the free mesial border of each levator muscle (the muscles as previously stated do not come together, but leave a long, narrow hiatus) the two fasciæ — levator, or superior; anal, or perineal — coalesce forming a rounded edge (Fig. 1). In the undissected state neither this edge nor the levator gap are visible from within the pelvis when viewed from above, because the accessory diaphragm or triangular ligament next to be described bridges most of the levator gap and fuses with the fascial edge just mentioned (Fig. 8).

3. The accessory pelvic diaphragm or *triangular ligament* fills in the space beneath the pubic arch nearly as far back as the tuber ischii (Fig. 2). It is composed of a thin sheet-like muscle, the deep transverse perineus, enclosed between two thin, but firm fascial

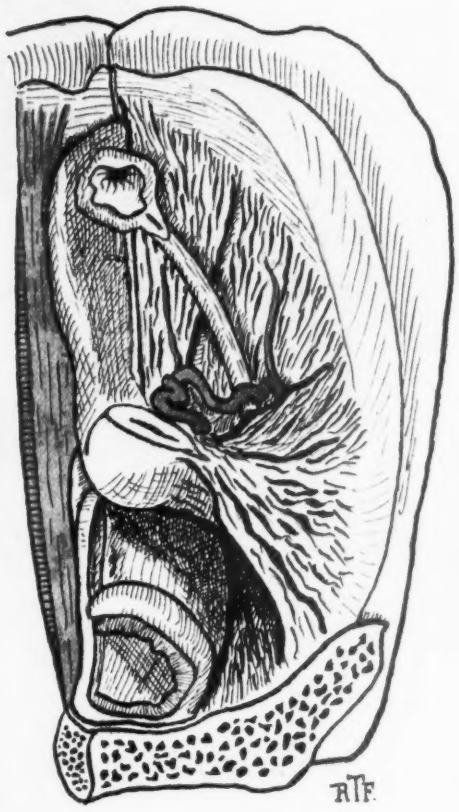


Fig. 8. Same model viewed from above. On the left side all tissue has been removed, so as to expose the pubococcygeal fibers of the levator muscle. Toward the median line is the vagina and cervix uteri. In the median line are seen urethra, ureteral opening and ureter, cervix cut across, and rectum. In the right half of the pelvis only the peritoneum has been removed. The uterine artery crosses the ureter after a superior vesical branch has been given off. A vaginal branch descends on the pubocervical ligament. The connective tissue forming cardinal and sacro-uterine ligaments are shown.

layers — the superior and inferior layers of the triangular ligament (Fig. 3). The free border of the transversus perinei profundus extends from the tuber ischii to the centrum perineale. The superior and inferior layers of the triangular ligament here coalesce so as to enclose the lower border of the muscle (Fig. 6). The triangular ligament obtains firm fixation by means of its attachment to

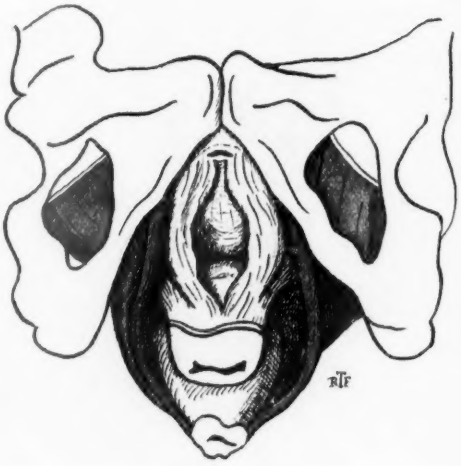


Fig. 9. Anatomy of cystocele. The cervix has been pulled down, the vaginal mucosa widely removed. The "bladder pillars" are shown in continuity with the cardinal ligaments.

the bone. The ligament is pierced by the urethra and vagina, thus affording support and fixation to these canals with the fasciæ of which it blends.

4. The meeting place of levator and anal fasciæ forming the rounded fascial edge, bounding the *levator gap* has been mentioned. Neither the gap nor the edge become apparent, because the superior layer of the triangular ligament blends with this junction point, five fasciæ meeting along this line, where the pelvic outlet is pierced by the vagina, levator, anal, superior and inferior layer of triangular ligament, and the fascia of the vagina (Fig. 3).

5. The rectum and anus pierce the pelvic diaphragm behind the triangular ligament. The sphincter ani unites with the posterior edge of this ligament at the centrum perineale. At a higher (deeper) level, the puborectal fibers of the levator insert into the anterior and lateral rectal wall. More posteriorly the levators unite in a median raphe behind (i.e. superficial to) the rectum (Figs. 6 and 7).

6. Viewed from within, the pelvis may thus be considered a cavity completely closed below, the diaphragm being pierced by the urethra, vagina, and rectum. Each of these tubes is invested by a thin but firm fascia

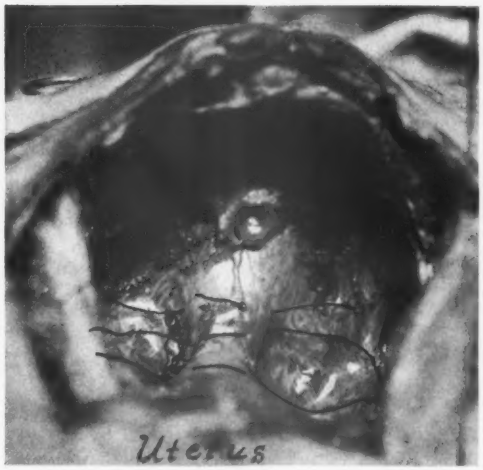


Fig. 10. Photograph of a cadaver dissection. The bladder has been removed and sutures passed as advised by Polk. Complete repair is possible only from below as the fixed portion of the bladder (here removed) interferes.

Fig. 11. Photograph of cadaver dissection. Enterocele seen from within. Uterus pulled over symphysis. In Douglas' cul-de-sac is a hernial orifice (through which the enterocele finds its way). To the left the peritoneum has been opened in order to trace the course of the hernia down to the perineal body.

propria as it passes through the triangular ligament or levator fascia. This fascia propria extends both upward and downward along each tube. The levator gap or hiatus in the normal pelvis is merely a potential gap or weak spot (Figs. 7 and 8).

(b) UPPER OR HOLDING APPARATUS

Both for the sake of simplicity and because it corresponds most closely to conditions found at operation, all fascial structures encountered within the pelvic (levator, coccygeus, pyramidalis) fasciæ will be considered as connective tissue. Anatomists have described bands, ligaments and aponeurotic sheets, and fasciæ in confusing profusion, depending largely upon the state of preservation of the cadaver, the method of fixation used, etc. The description here employed corresponds most nearly to that given by Poirier and Charpey (1).

The subperitoneal space (i.e. the space between the peritoneum and the levator fascia) is partly filled by the urethra and base of the bladder, the vagina, and uterocervical area, and the rectum. Blood-vessels, nerves, lymphatics, and ureters also traverse this space. All interstices are filled in by connective tissue of different consistence, varying from loose, fatty, areolar tissue to well-defined fibromuscular and elastic bands. This tissue encloses and fixes the organs but yet allows them the freedom necessary to permit of various degrees of distention.

Three main divisions may be described, all radiating from a common center, the uterocervical junction to the pelvic wall.

1. *Pubocervical* (*pubovesicocervical*) "*ligaments.*" Extending from the posterior surface of the symphysis and pubic rami strong fibers run back to the cervix, up to the level of the internal os on each side. These fibers blend with the fasciæ propriæ of both bladder and vagina near the median line, laterally becoming continuous with the anterior portions of the cardinal ligament. At a distance of about ¾ centimeter from the median line, a vaginal branch of the uterine (Figs. 7 and 8) runs downward in the pubocervical ligaments.

2. *Cardinal "ligaments."* Numerous strong bands radiate laterally from the cervico-

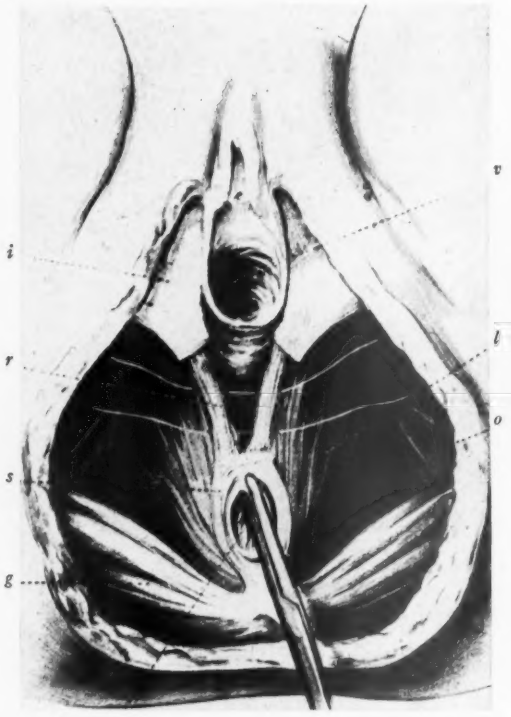


Fig. 12. Cadaver dissection to illustrate "levator suture." This figure, however, shows normal muscles and normal vaginal outlet. In prolapse the muscle is frequently stretched and atrophic, so that the sutures when tied separate the bundles and leave gaps. *t*, transversus; *r*, rectum; *s*, sphincter ani ext.; *g*, gluteus maximus; *v*, orificum vagina; *l*, levatore ani; *o*, obturator ani (From Doederlein and Kroenig).

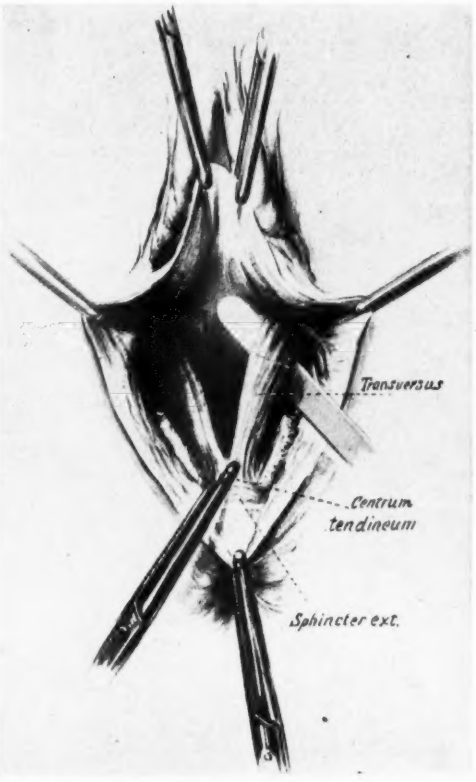


Fig. 13. The transversus perinei, here depicted, is often mistaken for the levator edge. Isolated suture of these bundles, give a weak, insufficient perineum (From Doederlein and Kroenig).

uterine junction in a fan-shaped fashion to each pelvic wall. At a lower level similar bands fix the lateral fornices and uppermost part of the vagina (paracolpium); at a higher level weaker bands form the lower part of the broad ligament (Fig. 8).[1]

3. The *sacro-uterine "ligaments,"* bands of very variable thickness and strength, run from the posterolateral cervico-uterine junction in a curved direction backward to the sacro-iliac joints. These bands form the lateral margins of Douglas' cul-de-sac (Fig. 8).

(c) PHYSIOLOGICAL IMPORTANCE OF THE SUPPORTING AND HOLDING APPARATUS

According to Halban and Tandler (3) all evidence is construed to signify that the muscles play the main or only rôle in maintaining the bladder, uterus, and rectum in position; according to E. Martin (2) the fasciæ are mainly responsible. The enormous and unwieldy literature can be referred to in these two monographs. To the unbiased observer both systems play important and co-ordinate rôles.

The holding apparatus (the subperitoneal

[1] The so-called broad ligament, extending from above the level of the internal os (uterocervical junction), plays no rôle in the support of the uterus, as it is flaccid and has little tissue except the two layers of peritoneum.

The round ligament is strong except near its insertion at the external ring. Its bow-shaped course and slack loop preclude its value as a suspensory or holding structure. It does serve to keep the uterus in anteflexion, and thus helps to guard against prolapse which usually begins with retroversion or flexion.

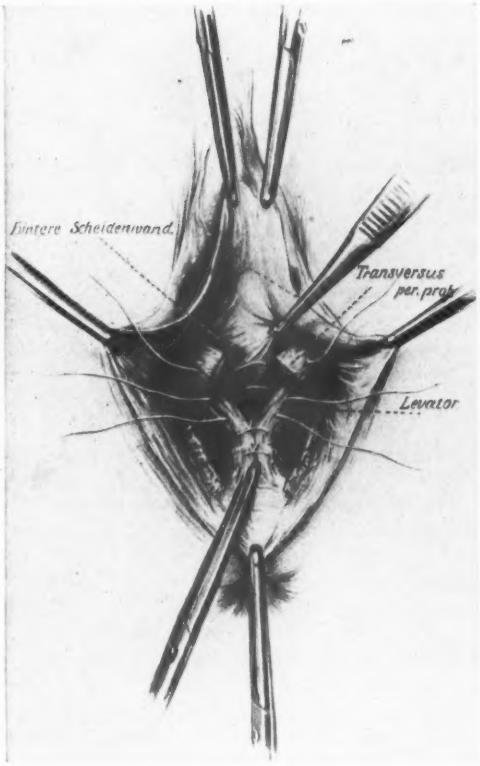


Fig. 14. To avoid the above error (Fig. 13) the authors advise cutting the transversus perinei and suture of the levatores. This results in a complicated dissection and suture (From Doederlein and Kroenig).

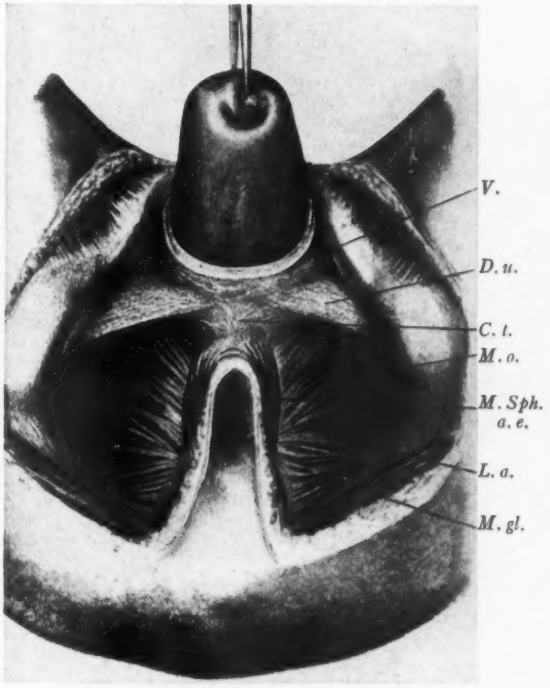


Fig. 15. This figure shows conditions in prolapse when the uterus is forcibly pulled downward. This puts the lax, defective triangular ligament on the stretch. Compared with Fig. 16, the levators and fasciæ are thin and weak (From Halban and Tandler — *Der Prolapsus*).

connective tissue) may be compared to an elastic sling which maintains the uterus in labile equilibrium in the pelvis, allowing descent in response to pressure from above, and allowing lateral or anteroposterior excursions in response to pressure exerted by neighboring viscera. As soon as the pressure ceases, the uterus is passively pulled back to its normal position.

The supporting apparatus (pelvic diaphragm) is a musculofascial plate which, both reflexly and in response to the will by its contraction, absorbs shocks, due to increased intra-abdominal pressure. The tonicity of the diaphragm in addition gives continual support to the holding apparatus.

The holding apparatus may fitly be compared to the springs which continually maintain the burden, and the supporting apparatus to the shock absorbers which ease exceptional stresses and strains.

From what has preceded, it must be clear that no operation dependent upon the utilization of one system will be applicable to each and every case. A thorough understanding, not only of the normal, but also of the pathological anatomy is necessary in order to be able to cure the varieties of prolapse.

3. Pathological Anatomy

Prolapse. In prolapse the holding apparatus (cardinal, sacro-uterine, pubocervical ligaments, etc.) has given way. In consequence, the uterus with the bladder and vaginal walls has descended through the levator hiatus, which is usually broadened (7 to 10 centi-

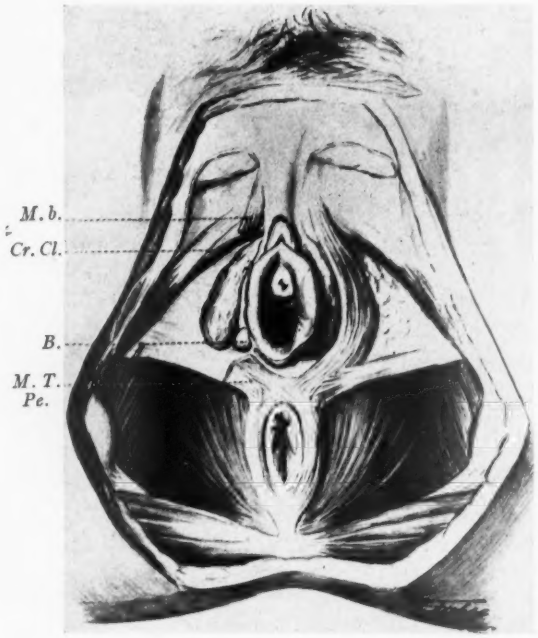


Fig. 16. Outlet of a nullipara. Note the shape of the triangular ligament. The regularity and firmness of the levators as compared with Fig. 15 (From E. Martin — *Der Haftapparat*, vol. 1).

meters instead of 3 to 4 centimeters) (compare Figs. 1 and 4).

Shortening of the sacro-uterine (Wertheim, Young, etc.) and of the round (Alexander's operation — which merely improves the position by anteflexing) ligaments is ineffective; effective reefing of the cardinal ligaments is impossible. To overcome the descensus, ventrofixation has been resorted to. Interposition may utilize the levator edges (Wertheim, 4), and vaginal hysterectomy seeks to shorten the sacro-uterine and cardinal ligaments, to which the vaginal vault is attached, by overlapping the stumps (Goffe, Mayo, etc., 5).

Cystocele. The bladder normally is retained in position by a sling-like fascial and connective-tissue plate, which is composed of anterior vaginal wall, pubovesicocervical ligaments and anterior part of the cardinal ligaments (Figs. 8 and 9). The fixed points are the posterior surface of the pubes and the triangular ligament below, and the anterior surface of the uterus at the level of the internal os above. During childbirth the fascial plate is torn and the movable part of the bladder (behind the ureteral orifices) gradually prolapses.

The weak spot can be repaired by utilizing the fascia propria of the vagina, the pubocervical and the anterior portions of the cardinal ligaments (Fig. 9). Polk's operation (6) unites the upper part of the rent in the region of the cervix, but the fixed portion of the bladder prevents successful closure of the lower segment. This weak spot can be reached only from below (*vide infra*) (Fig. 10).

Interposition keeps up the bladder, but at the cost of grave anatomical derangement.

Rectocele. The rectum normally is held in place by a thin but firm fascia propria, an investment which it receives when passing through the levator fascia. In the lower third of its course, the rectum and vagina are separated by the wedge-shaped perineal body; above they are in close contact (Fig. 7). The levator ani inserts along the lateral and posterior surface of the rectum, except near the anus, where the thin, sling-like mesial fibers (puborectal), after coursing along the sides of the vagina, find their insertion in the anterior surface of the rectum, perineal body, and sphincter ani (Figs. 6 and 7). The upper (pelvic) surface of the levator ani is covered by the levator fascia, the lower (ischiorectal) surface is covered by the anal fascia.

The levator and anal fasciæ are closely connected with the lateral and posterior surface of the vagina and with the layers of the triangular ligament. At about 2.5 to 3 centimeters from the vulva, these various fascial layers coalesce, forming a very firm, fixed support for the vagina (Fig. 3). Lateral tears of this region cause "lacerations of the perineum," usually accompanied by "rectocele," when the rectal fascia, which may be considered the investment of the levator fascia, given off as the vagina passes through this structure, is also torn. At times, only the rectal fascia is torn, in which case a rectocele bulges downward over an intact perineum.

The upper portion of the vagina owes its

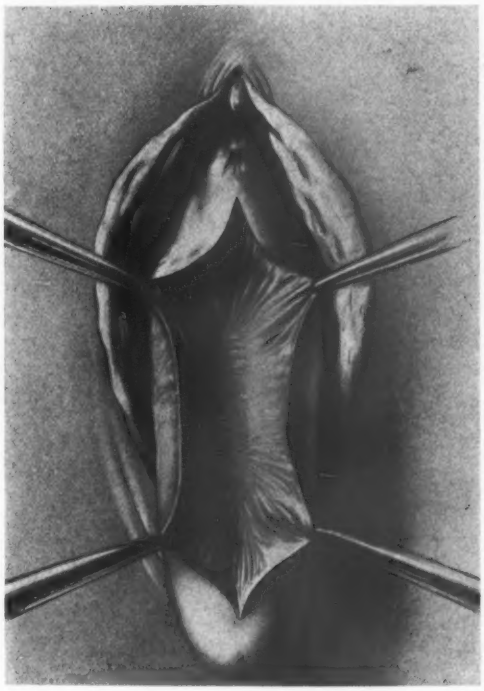


Fig. 17. Cystocele operation. (1) Narrow denudation in order not to disturb fascial structures.

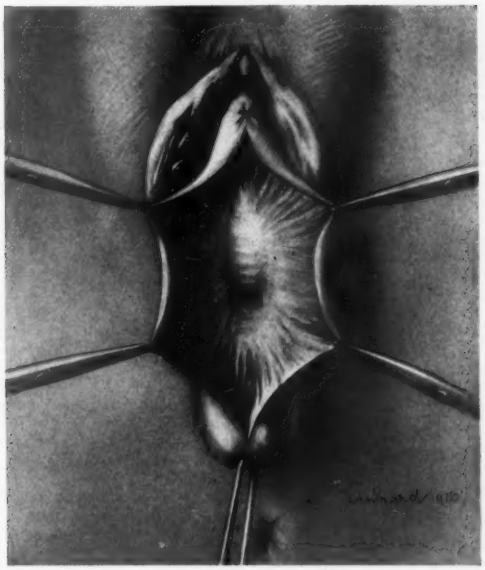


Fig. 18. Cystocele operation. (2) Pushing back of bladder in median line, blunt separation of vaginal flaps.

support mainly to the uterus. If this organ descends, the vagina invaginates and prolapses. If the thin, but firm fascia covering the posterior vaginal wall (lowest part of Douglas' cul-de-sac) is torn, a hernial protrusion may descend through the gap and present in the rectovaginal septum or protrude from the vulva, forming an "enterocele" (Fig. 11).

The upper portion of the rectum may form a similar protrusion if the rectal fascia is injured high up. The resulting protrusion is a "high rectocele." It corresponds to a "sliding hernia" of other parts of the body (as for instance sliding hernia of the cæcum).

To repair lacerations of the perineum and low rectocele, reunion of the fascial meeting place, previously referred to, may be resorted to. Levator suture is illusory, as the levator ani (puborectal portion) is a thin muscle slip not more than 2 to 3 millimeters in thickness and of scant breadth. Often after these fibers are brought together in the median line, the remainder of the muscle fails to be drawn together, and lateral pockets or defects result. Quite frequently, too, the high perineum obtained after levator suture is inelastic and very tender, producing severe dyspareunia. Finally, the operation necessitates the invasion of the excessively fragile perirectal veins and consequently favors embolism. For these reasons many operators have abandoned levator suture after prolonged trial (Figs. 12, 13, 14, 15, and 16). Suture of the fasciæ, on the other hand, not only approximates the muscles, but unites five fascial layers (*vide ante* Figs. 3 and 5) on each side to those of the opposite side.

High rectocele and enterocele can be held back only by closing the upper hiatus. Description of the operation (*vide infra*) sufficiently explains the anatomical repair.

The middle portion of the vagina has neither fixed points, nor is it in immediate contact with any fixed structures. Consequently only the rectal and vaginal fasciæ can be utilized. If fixation is required, re-

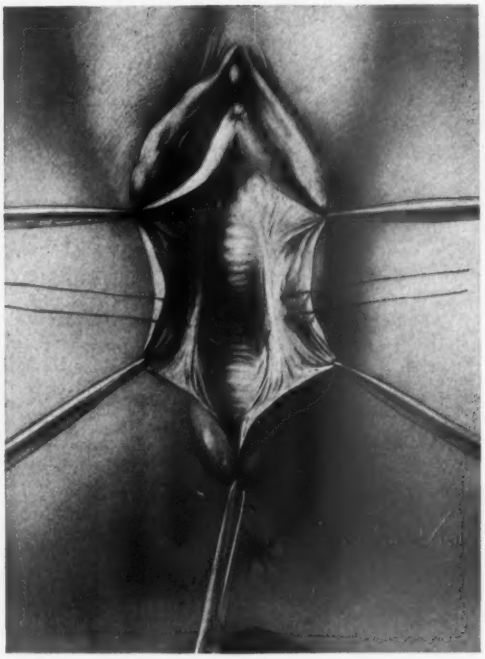


Fig. 19. Cystocele operation. (3) Exposure of "bladder pillars" (pubo-cervical ligaments) and insertion of cervical sutures.

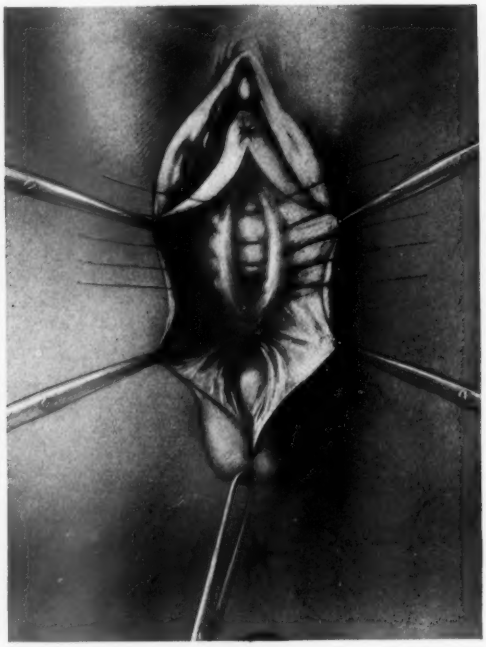


Fig. 20. Cystocele operation. (4) Cervical sutures tied, holding back bladder. Insertion of more anterior sutures.

course must be had to the upper (sacro-uterine) or lower (triangular ligament) fixed points.

4. Selection of Operation

The operation to be chosen in a concrete case of relaxation or tear of the pelvic floor will depend not only upon the anatomical changes noted, but also upon the age, social condition, and subjective complaints elicited. The ultimate result and both subjective and objective cure of the patient will depend almost as much upon the proper selection of the procedure as its operative execution.

a. Age. In a young woman who desires more offspring, extensive plastic operation should usually be refused or postponed until she has had a sufficient number of children. Pessaries, if applicable, may be employed palliatively in the interim. Only where deep cervical lacerations have caused miscarriages, or where as time passes an increase of the changes are noted, or severe disability is complained of should operation be performed at once.

The preceding paragraph explains our attitude toward minor degrees of rectoceles and cystoceles and possible pregnancies. After enough children have been born, sterility may be induced by ligation of the tubes.

Where the climacterium has been reached, the factor of pregnancy plays no further rôle. In old widows with severe prolapsus, the vagina may be narrowed, so as to leave a lumen merely sufficient for drainage (diameter of a fountain pen). Near the menopause the imminent involutionary changes must be taken into consideration (especially if vaginal interposition is contemplated, as subsequent shrinkage in size of the uterus may defeat the aim and object of the operation).

β. Lesions to be dealt with. (a) *Cervical.* When repeated abortions occur and where syphilis or other constitutional causes can be excluded, lacerations of the cervix should be

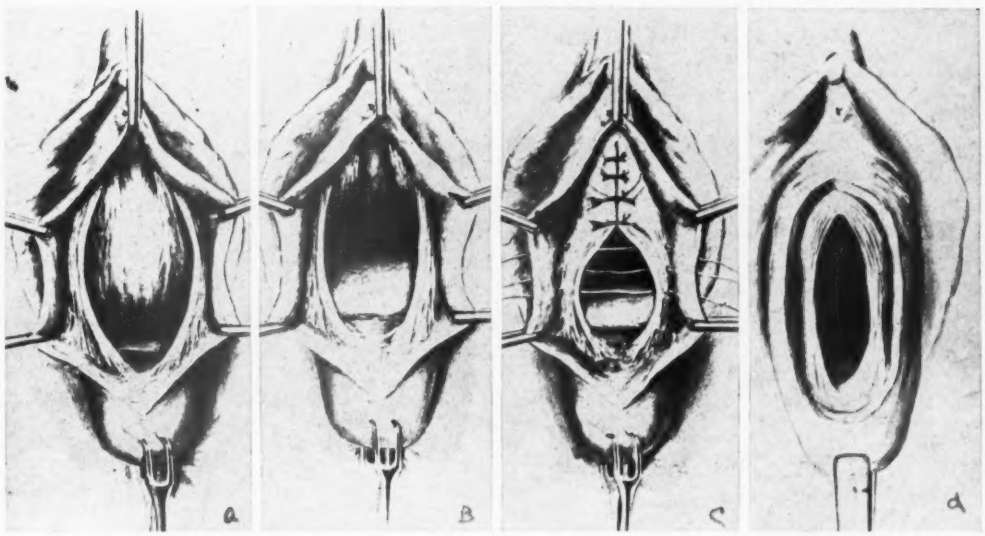


Fig. 21. Illustrating the steps of his repair of cystocele. (From E. Martin — *Haftapparat*, vol. ii.)

treated by uni- or bilateral trachelorrhaphy (Emmet's). Marked eversion, ectropion hypertrophy, cervical hypersecretion, may be relieved by low amputation (Schroeder's) in those cases in which symptoms develop. Usually amputation is only indicated in conjunction with operations for extensive prolapse, when future pregnancy can be excluded. Trachelorrhaphy is always preferable to amputation in the childbearing period (7). For painful scars in the fornix, excision of the scar in conjunction with trachelorrhaphy is indicated. High amputation flush with the vaginal vault is not a satisfactory procedure, favoring sterility, dysmenorrhœa, and backache, even when skilfully executed.

(b) *Rectocele and lacerated perineum* frequently annoy patients, because of the resulting feeling of prolapse and weakness. Either alone or in conjunction with a lacerated cervix, the lesion may be repaired, even during the childbearing period, if the perineum is not built up too high and the patient warned that the operation will *probably* be nullified by succeeding pregnancies. A rectocele can rarely be kept back by a pessary. When rectocele is complicated by enterocele (descent of Douglas' cul-de-sac) the condition is much more difficult to cure. Such may occur alone or combined with prolapsus. The special technique required will be described later.

(c) *Cystocele* alone is rare; usually a rectocele is also present. Childbirth will in most instances produce recurrence after operation. Therefore tempoıizing is especially indicated, unless sterility can be induced, because secondary cystocele operations are notoriously difficult and unsatisfactory. A pessary will relieve bladder symptoms in those cases in which there is coincident either movable retroflexion or a prolapse.[1] Pessaries are less successful in holding back cystoceles proper.

In cystocele the type operation to be described is advised, except in recurrent cases and in the few extreme cystoceles which are characterized by their globular shape and which have attained the size of a billiard ball. In these, vaginal interposition is less unsatisfactory than other procedures if, at the same time, a high and long perineum is built up.

(d) *Retroversion or retroflexion*, when combined with either relaxation or tears of the pelvic floor, require interference because they form the first stage of prolapse. Early cor-

[1] To determine whether the bladder symptoms are due to the uterine malposition is easy. If a pessary corrects both the displacement and the dysuria, operative correction is indicated.

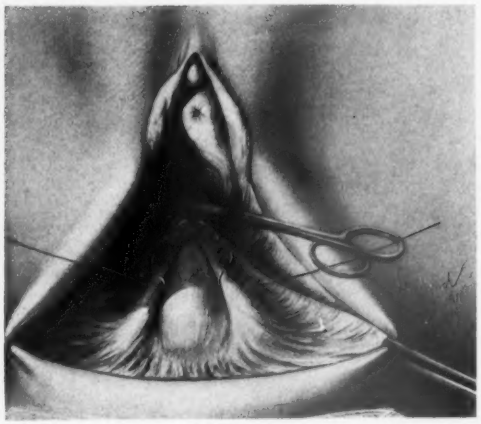


Fig. 22. Rectocele operation. (1) A deep horizontal purse-string suture has been passed from the patient's left. It first took in the triangular ligament, levator fasciæ, then the fascia recti propria, and the same structures on the right side. See Fig. 5.

rection is, therefore, indicated. In the childbearing period, movable malpositions may often be corrected by the use of the pessary, unless the perineum is deeply torn. In later life, if symptoms are complained of, or the condition shows a tendency to increase, operation is advisable.

Fig. 24. The sutures have been tied. Only the superficial perineal body and the skin perineum remain to be repaired.

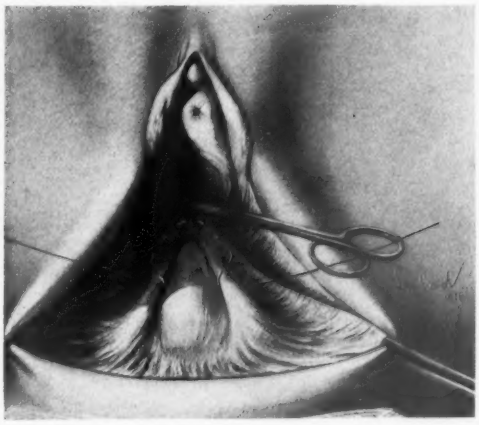
Fig. 23. Rectocele operation. (2) The purse-string suture has been tied holding back and fixing the rectum and diminishing the levator gap. Three additional sutures are passed below to approximate triangular ligament and levator edges.

Adherent retroversion or retroflexion, combined with vaginal relaxation or tears of the pelvic floor, usually requires interference, because of pain and backache.

The operations of choice during the childbearing period for movable retroflexion are anterior and posterior colporrhaphy, combined with the Alexander operation. If adhesions are present, a laparotomy should precede the shortening of the round ligaments (*vide infra*). If no more children are wanted, ligation of the tubes and ventrofixation may be employed to correct both movable and adherent malpositions.

An enormous number of operations have been devised and recommended to treat retroversion and flexion. Doubtless, some of them have special advantages. The writer has found the Alexander-Adams and ventrofixation sufficient and satisfactory, if properly selected.

(e) *Prolapse.* As prolapse of the uterus has a marked tendency to increase and produce progressive atrophy of the fascial structures, œdema and hypertrophy of the cervix, decubital ulcerations, etc., it is unwise to procrastinate, except in such very rare instances, in which future pregnancies are ur-



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gently desired, or where the physical condition of the patient (extreme age, pulmonary, cardiac, renal, or other disease) contraindicates interference. Various pessaries, such as the Meyer, Schatz, or even McIntosch may be employed palliatively in these cases.

If more children are wanted, anterior and posterior colporrhaphy and a tight Alexander may be performed. This operation is uncertain in its results under the given conditions, but it will at least greatly improve the prolapse and may even successfully withstand the test of repeated labors. Ventrofixation far down on the anterior surface of the uterus may not produce either miscarriage (third or fourth month) or dystocia at term. Usually this operation is inadvisable, because of the likelihood of dystocia. The type operation is amputation of the cervix, anterior and posterior colporrhaphy, ligation of the tubes, when necessary (age), and ventrofixation. Vaginal interposition, though highly recommended by some, does not appeal to the writer in prolapse. Where the condition of the patient is poor, vaginal hysterectomy with sewing together of the stumps and high perineorrhaphy is a shorter and fairly satisfactory operation, if the vagina is greatly narrowed. If recurrence takes place after either this operation or vaginal interposition, it is very difficult to improve the resulting disability by any operative procedure less radical than complete obliteration of the vagina.

(f) *Complete tears of the perineum* should be repaired as early as three to four months after labor, because of the social disability resulting from incontinence. The Tait flap-splitting operation with separate suture of the sphincter ani is very satisfactory.

(g) *Accessory troubles.* Occasionally vesicovaginal or rectovaginal fistulæ require repair. The subject does not fall into the frame of this discussion. Slight incontinence of urine, often complained of with cystocele, may be overcome by suturing the muscle fibers at the neck of the bladder and the torn fascia (triangular ligament) when the cystocele is repaired.

Cysts of the vagina, removal of hæmorrhoids, vaginal myomectomies, vaginal ligation of the tubes, etc., may be performed during the course of vaginal repair. During laparotomy, appendectomies, myomectomies, removal of cysts and of diseased adnexa, and even hysterectomies can be done. Umbilical or ventral herniæ may require closure. During the course of an Alexander's operation inguinal or even femoral herniæ are readily dealt with.

5. Preparation, Anæsthesia, Suture Material, Drainage

(a) *Preparation.* Before undertaking a plastic operation, local infections such as furuncles, eczema, or dermatitis must be cured by cleanliness, rest, applications of salves and cleansing douches (saline). Œdema of the cervix and decubital ulcers due to prolapse require no treatment, except bed rest, continued for days or weeks. Cystitis should be cured before operating. General conditions, such as diabetes, bronchitis, etc., should be improved by medical measures.

Before operation, the vulva, anal region, and, if laparotomy is contemplated, the mons and abdomen should be shaved. A dose of castor oil (1 ounce) given the night before operation, followed by a low enema in the morning, is sufficient preparation for the intestinal tract. One-half hour before inducing anæsthesia, morphine gr. 1/6 and atropine gr. 1/150 by hypodermic may be given in order to quiet the patient and lessen the amount of anæsthetic.

(b) *Choice of anæsthetic.* As a routine, the gas-ether combination has been employed in our work. For special indications, chloroform (emphysema), or gas and oxygen (nephritis, tuberculosis) are used. In isolated instances, local anæsthesia — alypin 2 per cent B-eucain 1 per cent — have been used for rectocele operations; tolerant patients complain of little discomfort, except when the deeper sutures are drawn together.[1] Trachelorrhaphy may be done without anæsthetization.

(c) *Suture material.* For all buried sutures, 10-day chromic catgut is employed. When

[1] Under local anæsthesia the involuntary resistance of the patient makes full and satisfactory exposure difficult in rectocele operation. In the writer's hands the results have been less satisfactory than under general anæsthesia.

placed very close to bladder or rectum, only fine sizes should be used, as coarse gut may "wander" into the bladder or become infected by the proximity of the rectum. The cervix has been found extremely tolerant to thick twisted silk, which remains *in situ* for 4 to 8 weeks, without producing irritation, and consequently reduces post-operative cervical hæmorrhage to a minimum. The vaginal mucosa has usually been sutured by us with interrupted silk of medium caliber. In extensive plastics, thin chromic gut may be substituted to avoid the inconvenience of removing inaccessible sutures later. Silk has been invariably used for the skin perineum. The perineal stitches may be removed any time after the sixth day, if they show evidence of "cutting through."

(d) *Drainage.* After curettage, trachelorrhaphy, or amputation of the cervix, a piece of iodoform gauze (5 per cent) 1 to 1½ inches wide has been carried up to the fundus and not removed until the fourth morning after operation.[1] A piece of iodoform gauze, sufficient in size to exert pressure on both anterior and posterior vaginal walls is inserted into the vagina at the end of the vaginal operations and removed at the same time as the cervical drain. The pressure exerted by the gauze reduces the amount of oozing.

If undue hæmorrhage is encountered during a cystocele operation (very rare), or during interposition, a small piece of iodoform wick may be led to the base of the bladder (or fundus uteri) between two adjacent mucous membrane sutures. A silk ligature attached to the wick and led out of the vagina facilitates its withdrawal (on the second day).

6. Postoperative Treatment

Sufficient morphine to insure moderate comfort should be given. Great depression of respiration or extreme scantiness of urine are contra-indications to the continued exhibition of the drug. As soon as the morphine can be stopped, deodorized tincture of opium gtt. V–X, b.i.d., are given to constipate the bowels until the third night. On the fourth morning a saline purge is given. Two hours later a low enema incites the bowels to evacuation.

Patients are allowed to urinate spontaneously. If retention is noted, they are catheterized every 8 hours (except patients with extensive cystoceles, Alexander's operations or ventrofixations, who are catheterized every 5 hours for the first three days, to avoid overdistention of the bladder). After each urination the vulva is irrigated with sterile water or weak bichloride of mercury solution (1:10,000) and covered with a dry sterile pad. Patients with complete tears of the perineum are kept constipated for 5 to 7 days. Castor oil is given to move the bowels, and an oil injection through a small catheter is given to soften the fæcal column.

During the period of constipation, patients receive fluids (except milk); after the bowels have been moved, soft, and then full diet.

Douches need only be given if there is profuse foul discharge (sloughing, discharging hæmatoma).

7. Operative Technique

A. CURETTAGE

Is always performed on every patient who has not passed the menopause. If signs of pregnancy (chorion) are found, no plastic should be done until involution is complete (2 months), as the danger of infection or of thrombosis and embolism is great, and operative bleeding is regularly excessive.[1] Curettings, suspicious of carcinoma, likewise, require postponement of plastic operations until a microscopical examination has been made.

B. TRACHELORRHAPHY (LACERATION)

Emmet's classical procedure is satisfactory. In the childbearing period, the denudations should be narrow. Silk through-and-through sutures, not entering the cervical canal, are used.

C. AMPUTATION OF THE CERVIX

(Erosion, hypertrophy, chronic endocervicitis). Schroeder's method of lateral incision, followed by wedge-shaped excision of anterior and posterior lips suffice. It is unnecessary to amputate at a high level, as hypertrophy diminishes markedly after operation, due to the circulatory changes produced. Many, apparently much hypertrophied cervices return to normal dimension without operation, if subjected to a week of preliminary bed rest. The silk sutures should be tied snugly, so as to

[1] If sudden high postoperative rises of temperature occur, it has been our custom to remove the gauze earlier, as retention of uterine secretion occasionally though rarely may cause this.

[1] Some patients who are ready to undergo a plastic operation conceive between the time they are last seen by the surgeon and the time of operation. Either deliberately or innocently they fail to mention that their period is overdue.

produce hæmostasis, but if the tension is too great, necrosis, and consequent severe and annoying post-operative hæmorrhage may result (seventh to tenth day). A gauze wick led through the cervical canal to above the internal ôs secures close apposition of the wound edges.

D. ANTERIOR COLPORRHAPHY

(Applicable to all but very large cystoceles, always the operation of choice, and only to be abandoned if absence of fascial structures is encountered).

a. Exposure. The cervix is grasped with a volsellum forceps and forcibly pulled downward. A small forceps (Ochsner) is applied to the mucosa ½ centimeter below the urethra. A vertical incision, just penetrating through the vaginal mucosa, is made between the two instruments. Starting from below upward, the vaginal mucosa is separated from the underlying bladder for a distance of only ¼ centimeter along the entire edge on both sides of the incision. The vaginal flap is made as thin as possible. To each edge two Ochsner forceps are applied (Fig. 17) as tractors. At the very bottom of the incision a few snips of a blunt scissors, cut across the so-called "vesical ligament" which serves to attach the bladder to the cervix. The gauze covered finger, by stripping upward and backward, strictly in the median line, now frees the lower margin of the bladder from the cervix (Fig. 18). As this is done, on each side fascial fibers, running upward and inward, become apparent. These are the "bladder pillars" (the pubocervical ligaments) which are invaluable in the repair (Figs. 19 and 9). Not until this dissection has been completed is it wise to separate the vaginal mucosa to the necessary distance laterally, because it is extremely easy to stray into a deeper layer, and thus either destroy or repeatedly buttonhole the "pillars" and the thin fascia which covers them, or to detach them from their continuity with deeper structures (anterior part of cardinal ligament).

β. Suture. After the vaginal flaps have been reflected and the bladder pushed up well above the peritoneal reflexion (Fig. 19), especially at the sides (behind the pillars), interrupted sutures of chromic gut are passed from side to side — entering one pillar, then catching the cervix, and again taking in the pillar of the opposite side (Fig. 19). The upper suture must be passed with care and not too deeply, as the ureters are in close proximity. When these sutures are tied, the bladder is held well up and back and is prevented from descending (Fig. 20).

At the upper end of the denudation, close to the urethra, a strong inverted V-shaped fascia will be noted. This forms part of the anterior layer of the triangular ligament. When this is approximated by transverse or mattress sutures of chromic gut, only a small portion of the bladder between the upper and lower sutured areas lacks reinforcement. This weak spot can now be closed, as the fascial edges, which have become demarcated far laterally by the traction of the tied sutures (and which draw the anterior fibers of the cardinal ligament toward the median line), are in turn drawn together by interrupted sutures.

After resecting a sufficient area of vaginal flap on each side (the amount, if not excessive, is of little importance), so as to leave an oval denudation, the mucosa is approximated with interrupted silk sutures.

By following the above directions closely, sufficient fascial structures will be found in almost every case, especially in large cystoceles found in conjunction with prolapsus. The fasciæ are most often destroyed or lost by operators who form large vaginal flaps or broadly denude, as their first step in cystocele operations. Other gynecologists deliberately cut through the "pillars," "in order to free the bladder edges." The bladder can be fully freed behind (i.e. cephalad) to the "pillars." These structures are especially valuable, not only because they afford good material for suture, but also as they serve both as guide and tractor to the deeper parts of the anterior portion of the cardinal ligaments.[1]

[1] In looking up the literature we find that E. Martin (loc. cit.) describes a very similar operation, which has been used at Bumm's clinic. The sutures unite the "pillars," but do not include the cervical tissues in their grasp (Fig. 21).

In the few cases in which no "pillars" and no fascia can be isolated, large cystoceles may be held back by the operation of—

E. VAGINAL INTERPOSITION

The operation has been described so frequently, and in such detail, that only a few special points need be mentioned.

The incision through the mucosa may be the same as that used for anterior colporrhaphy. Should atrophy of the fasciæ show the futility of the usual cystocele operation, the denudation is extended farther laterally, the remains of the bladder pillars are cut across, and the bladder is liberated upward by sharp dissection, in order not to push up the movable peritoneal reflection. When the reflection has come to view, the lateral bladder pouches are bluntly and widely freed. Hæmostasis should be exact and completed before opening the peritoneum.

No differences from the usual technique are used in developing the uterus, suturing the peritoneum to the posterior wall of that organ at the level of the internal os (this suture may be omitted), and ligating the tubes if necessary. Two silk sutures are passed below and to each side of the urethra entering the vaginal mucosa, passing through the anterior surface of the uterus close to and below the insertion of the round ligament, and again passing out through the vaginal flap on the same side. The uterus is now pushed upward and backward behind the symphysis so as to bring it well behind the edges of the levator gap. If possible, a few chromic gut sutures fasten the anterior surface of the uterus to the V-shaped part of the triangular ligament below the pubic angle. The vaginal flaps are resected and sutured over the uterus. In case of profuse oozing, a small gauze drain is lead between sutures to the anterior surface of the uterus.

Before doing the interposition, all necessary cervical repairs should be completed. In complete prolapse the writer does not employ interposition, as he has found the sacro-uterine ligaments weak and not dependable structures, and their vaginal shortening through the anterior fornix an unsatisfactory procedure.

Interposition, moreover, not infrequently produces intractable bladder symptoms, even in cases in which the anatomical result may appear perfect.

F. COLPOPERINEORRHAPHY

Colpoperineorrphy must be considered under three headings, depending upon the extent of the tear and upon the structures involved.

α. Tears of the perineal body are repaired by reuniting the superficial muscles (transversus perinei superficialis, bulbo cavernosus, and sphincter externus) and the transversus profundus and its fasciæ (triangular ligament).

β. Deeper tears require that the rectum be held back in order that levator ani and its fascia can also be approximated. Above this barrier, the rectum must first be supported and reinforced.

γ. More pronounced descent of the rectum or of the Douglas' cul-de-sac (enterocele) may result independent of demonstrable lacerations. The cause, nevertheless, in most instances, is directly due to the trauma of childbirth. Repair of the lower two segments in these cases would cause but little improvement. The peritoneal reflection may appear at the vulva, and the pouch may contain intestine. Not infrequently, the anterior rectal wall also prolapses through the vulva as part of the protrusion. The hernial opening is bounded laterally by the sacro-uterine ligaments. This upper hernia in the pelvic floor must first be repaired before the levator and transversus are united.

α. *Perineorrhaphy.* Almost any operation, including the flap splitting gives good results, if the tear merely involves the perineum and triangular ligament. This implies that the fascia covering the anterior surface of the rectum has not been torn, and that the rectum does not protrude. The edges of the levator muscle rarely recede far laterally under these circumstances. Consequently approximation of triangular surfaces on each side (with base toward the skin surface) restore the parts to approximately normal conditions. As most descriptions of perineal operations deal with the repair of these superficial lesions, we so often hear of "100 pei cent of cures," of "uniformly good results."

We employ a simple triangular Hegar denudation reaching the top of the tear. A buried running suture of chromic gut approximates the fascial structures. The mucosa and skin are closed with silk.

β. *Colpoperineorrhaphy.* The object is to hold back the rectum, and approximate the lower levator fibers (puborectal), and then, as in simple perineorrhaphy, the accessory structures (perinei profundus and superficialis with their fasciæ). The denudation is made from the crest of the rectocele to the labia (triangular Hegar).

The beginner may employ the following method to judge of the extent of the denudation. It must be possible to draw the spot seized as "the crest of the rectocele" up to the urethral orifice, without great tension. The spot selected on the labia must be below the

Bartholinian openings. The future size of the vulva can be determined by crossing the instruments which grasp the labia in the median line. Of equal importance is the height at which the levator edges and triangular ligament are to be united. The point at which this union is brought about (by the first deep suture) is approximately 2.5 to 3 centimeters within the vulva, where the descending rami of the pubes are in close proximity to the lateral vaginal wall. Two instruments catching hold of the lateral tissue at this level (along the line of the proposed denudation) and drawn together in the median line will show the size of the proposed canal and the height of the new perineal barrier. If scar tissue causes the rectum to adhere laterally, the bowel must be liberated by pressure with the finger and pushed sufficiently away to expose on each side triangular areas of fascia covering the levator and transversus perinei profundus. Three steps now remain to be taken: (1) the rectum must be held back at a high level, and redundancy corrected; (2) the levators must be brought together; (3) and the perineal body and vulva restored.

(1) *Fixation of rectocele.* A horizontal purse-string suture is passed, starting at the level at which the levators are to be united. The stitch first takes a deep lateral bite (levator and fasciæ), and then passing upward toward the cervix catches the perirectal fascia (fascia recti propria) which is found close to the edge of the denudation, finally ending in a deep bite on the opposite side, which again takes hold of the levator (Figs. 5 and 22). When this stitch is tied, the upper posterior vaginal wall is found narrowed, and the rectum not only held back, but also fixed at a higher level.

(2) *Union of the levators* (puborectal fibers). In the median line the finger still can touch the rectum below the first suture. Deep lateral transverse sutures of chromic gut are now passed, one below the other (usually three), which take in the fascia covering the levators at their junction with the triangular ligament (Fig. 23). When these sutures are tied, the rectum is completely shut off below (Fig. 24).

(3) *Repair of the perineum,* as described under perineorrhaphy (*a*), completes the operation. The operation is much simplified by suturing the mucous membrane step by step as the deep sutures are tied.

Colpoperineorrhaphy not only narrows the vaginal outlet and the lower vaginal canal, but also narrows the levator gap and forms a good resilient, sling-like perineal body. It, likewise, fixes the lower portion of the rectum, but it fails to hold back either that portion of the rectum situated between the cervix and the new barrier or a deep peritoneal cul-de-sac through which intestine may prolapse in this same region. This upper weak spot is also not affected by ventrofixation of the uterus. Thus, though the cervix may be high and fixed, the perineum firm, the lower vaginal canal narrow, yet an uncorrected protrusion may exist in the middle of the vagina. Sooner or later after operation such an enterocele or a "high" rectocele will then begin to project over the perineal body and extrude through the vulva.

γ. Repair of enterocele and high rectocele. To simplify the operation two areas of denudation are laid out by applying Ochsner forceps. The first forceps is placed at what would correspond to the crest of the rectocele. The cervix is now exposed. With the cervix as the upper point, an Ochsner is placed laterally on each side between the upper and lower limits. An oval denudation of the posterior vaginal wall is then made within these fixed points.

1. The peritoneum may be pushed back, or may be opened and obliterated from within as high up as possible by means of a catgut purse-string suture.

2. A slight amount of blunt dissection exposes the sacro-uterine ligaments, subperitoneally. Laterally the rectum is separated for ½ inch from the vaginal mucosa. A purse-string suture of medium chromic gut is passed, taking in the left sacro-uterine ligament, the posterior wall of the cervix (above the fornix), the right sacro-uterine ligament, the rectal fascia, exposed by reflecting the vaginal mucosa. When this stitch is tied no protrusion of peritoneum or rectum remains. The mucosa is sutured in turn.

3. The further repair is that described under colpoperineorrhaphy.

G. ALEXANDER'S OPERATION

The technique of this operation has been so standardized that no description is necessary. If the external inguinal ring is properly exposed without distortion of the tissues by hæmorrhage or trauma, the round ligament can be seized and pulled out without even incising the fibers of the external oblique. For fixing the shortened ligaments either chromic catgut or fine silk may be used.

If the uterus has first to be freed before it can be antiflexed, a transverse skin incision, close to the pubis, may be made. Through this cut the abdomen may be opened by a short paramedian vertical incision through the rectus muscle. After the abdomen has been closed, an Alexander's operation can be performed through the same skin incision. Difficult intra-abdominal manipulations are somewhat hampered by the smallness of the abdominal incision.

H. VENTROFIXATION

This operation, also, has been fully standardized. Either the fundus or the cervical stump may be sutured to the fascia. By extraperitonealizing the fundus of the uterus very firm and permanent fixation is obtained. It is well to make the incision paramedian (through one rectus muscle) and to use medium silk for the fixation sutures. The fundus should be anchored about two finger's breadth above the pubis, so as to allow sufficient space for the bladder to expand. Very flabby abdominal walls are unsuitable for ventrofixation, as they permit the fundus to draw the parietes downward and inward in the shape of a funnel. Ligation of the tubes has been previously discussed. Division of the tube between two silk ligatures has sufficed in our hands.

8. Conclusions

With very few exceptions, anterior and posterior colporrhaphy combined with either the Alexander operation or ventrofixation are applicable to all cases of prolapse or cystorectocele and retroversion both during and after the childbearing period.

The technique of these plastic operations can be learned as precisely as that of inguinal hernia, if the student is taught the regional anatomy. To obtain the proper dimensions of the reconstructed canal, however, requires considerable experience and proficiency in operating.

The disadvantage of the described technique is the considerable time required. A rapid operator cannot complete curettage, amputation of the cervix, anterior and posterior colporrhaphy, ligation of the tubes, and ventrofixation in much less than 90 minutes. In some cases (though very rarely) it may prove advisable to perform the vaginal plastic and the abdominal fixation at separate sessions (two weeks interval). Even old women stand this extensive operative interference surprisingly well. Only in the few cases, where the general condition of the patient is precarious, must interposition of the uterus or vaginal hysterectomy be given the preference, because of the shorter time necessary in their execution.

9. Summary

The interposition operation is simple, but its disadvantages (necessity for sterilization, bladder symptoms, recurrence of protrusion after operation for prolapse) have become increasingly apparent. The suture of the isolated levator muscle is illusory, and, even when the cosmetic results are good, a painful scarry perineum is often noted.

The technique described in this article, which for repair of cystocele utilizes the pubocervical ligaments and anterior fibers of the cardinal ligaments, for repair of rectocele unites the fasciæ of the rectum, the fasciæ of the levator muscle, and the triangular ligament, is very generally applicable, the exceptions being few and easy to recognize. Sterilization is not a prerequisite to the operations.

The repair of enterocele and high rectocele is also described. Operations for these rarer conditions are more difficult and atypical.

Recurrences must be expected in at least as many cases as follow hernia operations (in general 1 to 10 per cent).

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MALIGNANT PAPILLARY ADENOMA OF THE KIDNEY

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THE purpose of this present writing is not to enter into a detailed discussion of malignant tumors of the kidney, but to draw a parallel between them and the tumor called malignant papillary adenoma of the kidney, a condition of sufficient rarity to warrant the publication of a case.

The most frequent tumor of childhood is the one generally known as Wilms' tumor. The histopathology of this class of tumors is so varied that it introduces into the literature a great deal of confusion in regard to diagnosis and nomenclature. The microscopical picture shows a predominance of epithelial cells in some portions of the section. The cells are arranged in tubules and solid masses bearing resemblance to carcinoma.

The tubular structure forms as a rule a characteristic feature of the tumor; in other portions of the same section one finds a predominance of spindle and round cells having the appearance of sarcoma. Striped and unstriped muscle-tissue as well as hyaline cartilage is frequently met with in sections from this type of tumor; hence its name mixed tumor (Fig. 1).

There is no doubt that many a case reported in the literature as carcinoma of childhood belongs to this group of tumors; the diagnosis of carcinoma being based probably upon the study of carcinomatous-like areas only.

To Birch Hirshfeld (1) we are indebted for having first cleared up the confusion that existed in regard to these tumors. According to him they are embryonal adenosarcomata and are derived from the wolffian body.

Wilms (2), who has made an extensive study of the subject and by whose name they are generally known, believes that these so-called mixed tumors originate from very early inclusion within the nephrogenic tissue of portions of the primitive myotome.

Busse (3), Trappe (4), Herzog (5), and others have somewhat modified these conceptions yet the pathogenesis of these tumors is at present by no means a settled question since many data of the embryology of the kidney are still *sub judice*.

The most common renal tumor of the adult is the Grawitz tumor, generally known as the hypernephroma. Whether or not this tumor originates in the suprarenal rests as suggested first by Grawitz (6) or results from altered renal epithelium during the process of chronic interstitial nephritis as described by Stoerck (7) is still a debatable question.

The explanation given by Adami (8) is, in our opinion, the simplest and most rational of the three. According to him they are renal mesotheliomata taking their origin from proliferating islands of nephrogenic tissue (mesoblast) which is derived from fœtal wolffian ducts that have never become connected with renal tubules.

Histologically, they consist of stroma of capillaries in the meshes of which there are scattered the tumor-cells which rest directly upon the endothelium of the capillaries.

They are as a rule large, polygonal, and refractive. Not infrequently they are arranged in columns bearing resemblance to the cortex of the adrenals. The fat content of the cells, if present, constitutes an important diagnostic point; however, according to Burkhardt (9) it is very often diminished or absent. The presence of glycogen is of little diagnostic significance since a large number of embryonic tissues and rapidly growing tumors contain glycogen (10) within their cells.

Lecithin was found by Gatti (11) to be a constant feature of hypernephroma. However the difficulty of its microchemical detection makes it of little diagnostic significance.

Figure 2 illustrates the histopathology of this type of tumors.

True malignant new-growths that originate in the adult renal epithelium are exceedingly rare, and it is only within the past few years that they have been differentiated from the above-described malignant tumors of the

kidney. The rarity of this class of tumors can be readily understood from the statistics of Albarran and Imbert (12) who found only 13 malignant adenomata out of 529 cases of renal tumors. Tumors described as malignant papillary (cyst) adenoma to which group of renal tumors our case to be described below belongs is still more uncommon. Kretchmer and Moody (13) have collected 10 similar cases from the entire literature and have added a case of their own. With the report of our case there will be a total of 12 cases of adenopapillary tumors of the kidney recorded in the literature.

The history of our case is as follows:

The patient, A. H., male age 30, admitted to Nicholas Senn Hospital March 2, 1916.

Family history: father died at age of 56, cause unknown. Mother died of cancer at the age of 67. One brother and four sisters are living and well. His past history was negative, except that he was operated on 7 years ago for suppurative appendicitis, and a drain was used; he was three weeks in the hospital and recovered nicely.

His present illness began last fall with pain in the stomach region, not affected by eating. From this time on he began to get weak. The stomach pains ceased at the end of two weeks and he was free from them until three weeks ago, when he had pains in his upper abdomen worse than before. Was in bed two weeks, got up for a day and went back to bed again until he entered the hospital.

His physician stated that his temperature ranged from normal to 102°. During the last attack he had rather constant pain in the right iliac fossa. He had no headache. He was slightly jaundiced in the beginning of this attack, but it had disappeared. He vomited several times recently; has had several chills, followed by a rise in temperature. He uses alcohol moderately. Has had no venereal disease, and no symptoms pointing to the urinary tract. He has never had blood in the urine. Has no nocturia or hæmaturia and a urinalysis was negative as to albumin, blood, and casts.

Upon entering the hospital he had the appearance of being ill. His temperature was 99.6°. Examination of the chest was negative; abdomen negative except that the liver dullness was two fingers' breadth higher than usual. The lower edge of the liver could be plainly felt on a level with the umbilicus. It was smooth and had the normal consistency; a mass could be felt as though protruding from under the liver in the right hypochondriac region. This mass was thought to be the gall-bladder, a retroperitoneal tumor, or the kidney. The mass was not tender and there was just slight tenderness in the epigastrium, but in the McBurney region the tenderness and rigidity were quite marked.

Blood examination showed: erythrocytes, 5,000,000; leucocytes, 9,000; polymorphonuclear, 72 per cent; large lymphocytes, 6½ per cent; small lymphocytes, 20½ per cent; mononuclears, ½ per cent; eosinophiles, ½ per cent.

Gastric contents after taking a test breakfast showed: total acidity 60, alizarin 40, combined hydrochloric acid 20, free hydrochloric acid 35, total hydrochloric acid 55, acid salts 5.

Occult blood negative with benzidine.

X-ray examination by Dr. F. H. Kuegle: Right diaphragm is flat and 1½ to 2 inches higher than normal. Movement is restricted 2+. There is a large shadow, which merges with the liver and cannot be differentiated from it, extending downward on the right side 1½ to 2 inches below the navel. The stomach examination shows the organ of normal size but vertically placed with the pyloric end pushed to the left of the median line.

On March 6, the patient was operated upon by Dr. A. P. Condon. An incision was made through the right rectus muscle. The mass previously felt protruding beyond the edge of the liver, proved to be the kidney from which has sprung a large tumor. The tumor seemed to take its origin from the upper pole of the kidney, pushing the kidney downward and forward until it was quite superficial. An incision at right angles to the rectus muscle was made, extending well around toward the lumbar region, and the kidney and tumor springing from it removed without much difficulty.

The left kidney was palpated, but seemed normal. The appendix was buried in adhesions around the cæcum, it was twice its normal size, and the vessels markedly injected, the distal third containing a small abscess. The appendix was removed. No enlarged glands could be felt in the abdomen. The fever that the patient had been having was undoubtedly due to his appendicitis. The patient got along well and left the hospital on April 2.

Pathological report: The renal mass measures 20x13.5x11.25 centimeters, and weighs 5½ pounds. It presents the appearance of an enlarged kidney and has a nodular surface. The entire mass is covered by a dense fibrous capsule and is of whitish gray color except the anterior part of the middle third of the mass which has the color of a normal kidney. Upon incision the kidney is entirely replaced by the tumor except at the upper and middle thirds. At the upper pole a very narrow zone of kidney-tissue measured transversely 3¾ centimeters and 5 centimeters longitudinally. This portion of the mass corresponds with the pelvis of the kidney which is filled out with projections of tumor-tissue which can be shelled out and in parts leaving behind it a smooth walled pelvic region.

From the middle third the kidney substance passes into the lower pole at which part it cannot be differentiated from the tumor itself.

The tumor mass is subdivided into three distinct lobes which correspond to parts described above. The consistence of the tumor is rather firm; in one

Fig. 1.

Fig. 1. Low power microphotograph illustrating histology of a Wilms tumor. Tumor removed from a boy 23 months old. Tumor was accidently discovered by mother; no hæmaturia. Patient died 17 months after operation of what was thought to be bronchopneumonia. (Metastasis?).

Fig. 2.

Fig. 2. Low power microphotograph showing histology of hypernephroma. Tumor removed from right kidney; patient 55 years old, female; hæmaturia for several months. Operation, May 21, 1913. At present enjoys good health.

Fig. 3.

Fig. 3. Low power microphotograph showing glandular structure of tumor.

or two places it is soft. The renal vessels are not invaded by the tumor (Fig. 4).

Section from lower pole shows a very marked glandular proliferation; the lumina of some of the glands are filled with projecting villi which consist of a stalk of connective tissue beset by proliferating epithelial cells. Fine strands of connective tissue are found around aggregations of glands as well as among individual glands. The glands are lined by large cuboidal cells that contain rather an abundance of protoplasm; the nuclei take deep hæmotoxylin stain and are located at the center of the cells. The cells do not show any fat when stained by sudan III. However, there is scattered throughout the connective tissue fat-droplets. The lining cells of the projecting villi are of the same character as those of the glands themselves. Section from the middle and upper thirds show a similar picture except some hæmorrhage in interstitial tissue.

The kidney tissue adjacent to the tumor presents marked inflammatory changes of the chronic interstitial and parenchymatous character. The sections show newly-formed tubules which are elongated, and the epithelium shows many mitotic figures. In places one can trace a distinct transition from the newly-formed tubules into glandular structure of tumor. (Figs. 3, 5, and 6.)

The existence of a primary adenoma or carcinoma of the kidney is denied by some, basing their argument upon the mesodermic origin of the kidney. However, we believe that this view is untenable; since the renal tubules are lined by epithelium of whatever layer of the blastoderm it comes from, and therefore any tumor arising from it can justly be called adenoma, carcinoma, or adenoma carcinoma.

An analgous condition one meets with in carcinoma of the uterus; although this organ is derived from the mesoderm yet no one will deny the existence of a primary carcinoma of the uterus.

In our case of adenocarcinoma of the kidney we could trace as pointed out above transition from renal parenchyma into tumor formation. The tissue from middle third of

Fig. 4. Note extent of tumor which replaced kidney tissue except at upper (*a*) and middle (*b*) poles. Section for microscopical examination taken from upper middle and lower thirds stained by hæmotoxylin and eosin, Van Gieson and by sudan III for fat (frozen sections).

Fig. 5.

Fig. 6.

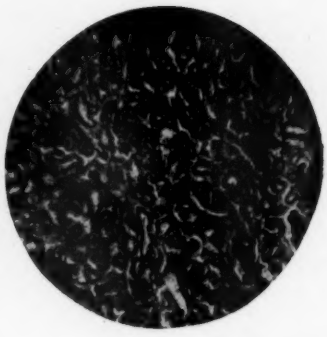

Fig. 7.

Fig. 5. High power microphotograph of tumor tissue.
Fig. 6. Low power microphotograph showing papillary processes filling up lumina of glands.
Fig. 7. Low power microphotograph showing tendency of tumor to mimic tubular structure of kidney.

tumor showed great tendency to mimic tubular structure of the kidney (Fig. 7).

Whether or not the chronic inflammatory changes of the kidney have anything to do with the formation of the tumor cannot be stated definitely, yet that it may play a part in tumor formation seems to be quite a logical supposition as it is well known that chronic mastitis or chronic ulcer of the stomach often is followed by cancer formation. That adeno-papillary tissue can take origin from kidney tubules was recently pointed out by Dunn (14).

SYMPTOMS AND DIAGNOSIS

From the few cases reported in the literature it will be impossible to build up a clinical picture from which this kind of renal tumors could be diagnosed. Suffice it to say that the diagnosis must remain that of renal tumor and it is left to the pathologist to diagnose the nature of the tumor. Among the symptoms which are in common with other renal tumors, hæmaturia was observed in 8 out of 12 recorded cases. Colic was a rather constant symptom being present in 11 out of 12 cases.

AGE

All but three occurred in people past 40.

As regards sex, there were three females and nine males. The prognosis depends upon early operative interference. If there has been no metastasis at time of operation, the patient stands a better chance of remaining free from recurrence, than if affected with any other malignant tumors of the kidney.

Although too short a time has elapsed since the operation to judge upon recurrence in our case, yet X-ray plates taken at the time of his dismissal from the hospital, failed to reveal any metastasis in any part of the body.

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OPISTHOTONUS FŒTUS

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THE condition here presented may be considered under three headings: (1) the rarity of the presentation, (2) the difficulty of diagnosis, (3) suggestions as to the management of such cases.

The condition can best be defined as an opisthotonus of the fœtus with the concavity of the back directed downward and slightly forward with extension of the thighs and extension of the arms over the head. A consideration of the accompanying illustrations gives the best idea of the condition.

A careful review of the literature and of the various textbooks reveals no pictures or descriptions of a similar condition. Dr. C. S. Bacon says he has never seen such a case and knows of none in the literature. Dr. J. W. Williams in a personal communication says he has never seen such a presentation and the only references that he knows of in the litera-

Fig. 1. The drawing illustrates the conditions present when delivery became imperative because of the poor quality of the fœtal heart tones. Note that the arm has descended so that both elbow and knee can be felt in the partially dilated cervix. Spontaneous version and delivery can be seen to be highly improbable irrespective of the condition of the child.

Fig. 2. Note the extension of the arm over the head. The value of the X-ray in the diagnosis of presentation and position is well illustrated, Fe, femur; Hu, humerus; J, jaw; O, orbit; Pel, pelvis; Sc, scapula; Sp, anterior superior spines of the ilia.

ture are two which he has kindly sent me. They have to do with fanciful drawings in some old obstetrical books.[1]

Dr. J. B. De Lee in a personal communication tells me that he had a similar case about ten years ago. The child was delivered with great difficulty. He emphasizes the difficulty of diagnosing these presentations from external examination. Dr. J. Clarence Webster states that he has never seen a similar case, and has not heard of one being reported.

It therefore would appear that this condition is so uncommon that a description is desirable. Inasmuch as I have been unable to find a counterpart in the literature, the name opisthotonus fœtus is suggested for the position. The difficulty of diagnosis is great. The physical findings are obscure and confusing. The problem is well illustrated by the case at hand.

I first saw the case about two weeks before term. There was no history of abnormal signs or symptoms during the gestation. She had had three children, all born at full term spontaneously. On examination the abdomen was found to be neither fat nor rigid and so permitted of rather detailed observation. The long axis of the uterus lay in the transverse diameter of the abdomen. In the fundus could be felt a bulky mass which did not resemble either a head or a breech. On the left side just above the iliac fossa the head could be distinctly felt. A nodular mass resembling a breech was palpable over the inlet. The heart tones were in the left upper quadrant. Vaginally small parts could be felt through the lower uterine segment. The pelvis was of good size and no bony outgrowths or tumor masses could be detected. The cervix was not dilated or effaced.

A tentative diagnosis of transverse presentation with a shoulder presenting was made. An attempt was made at external version. I was unable to accomplish this because the mass over the inlet could not be displaced although the head could be moved over until it came to lie almost over the inlet. On releasing the head it returned immediately to its former position. This rather free mobility of one pole of the fœtus with an apparent fixation of the opposite pole seems to me to be a rather significant sign; but at the time I was unable to interpret it. The findings were confirmed by Dr. Bacon and I then had an X-ray examination made. Two pictures were taken, but unfortunately they were not very clear. They gave enough detail however to establish the diagnosis which at the time was considered sufficient; and so further X-ray pictures were not made.

A second version was attempted in the light of the knowledge obtained from the X-ray; and I tried to flex the body at the same time. Again the version was unsuccessful, due in part at least to an increased irritability of the uterine and abdominal walls at this time.

Differential diagnosis before the X-ray was taken involved several possibilities:

First, a transverse presentation with the shoulder presenting was considered. The points against this were the inability to accurately map out the breech except for the nodular mass over the inlet, and the presence of the heart tones in the left upper quadrant. The other findings might very well have fitted this picture.

Secondly, twin pregnancy with one baby transverse. The points speaking against this were: the absence of a second heart beat: the abdomen was not unduly distended: only one head could be palpated: there was no multiplicity of small parts.

Thirdly, a monster of some type. This of course could not very well be ruled out on any external examination.

Treatment in such cases varies somewhat, naturally, with the period of gestation and the time at which the diagnosis is made or suspected. It is possible or even probable that version attempted in this case in the early part of the seventh month would have been successful and the child would have presented in the normal flexed position. My reason for this statement is that after delivery the child could be made to assume the attitude of the normal child *in utero* with no difficulty. It

[1] Roesslin. Rosengarten fur Schwangere Frauen und Hebammen, 1514. Reuss de Conceptu et Generatione Hominis, Frankfort: 1580, p. 35.

was perfectly formed and no bony defects could be noticed on careful examination.

In the present case it was thought best to allow the woman to go into labor without any special treatment. The membranes ruptured shortly after the labor started and she entered the hospital with the cervix dilated to the breadth of two fingers.

Internal examination revealed a knee and elbow presenting. This I could determine accurately by following the forearm up to the hand and the thigh up to the genital fold, After attempting an external version again, even though it offered little hope of success, and failing, it was decided to allow labor to proceed to see if spontaneous version would occur. After four hours of rather good pains the baby's heart tones became very faint, and the pains became very weak. The cervix was only about three fingers dilated but it was decided to deliver the woman at once in the interest of the child. Dr. Rohrlach did an easy extraction, but the child which was in asphyxia pallida could not be revived. Efforts in this direction were maintained for over an hour. A post-mortem examination was refused by the mother. No abnormality could be detected on careful external examination of the body.

In reviewing the case I believe that a better way to manage such a presentation would be to insert a bag outside the membranes as soon as the pains start. The object of this would be to protect the membranes until complete dilatation of the cervix and so preserve the liquor amnii for the subsequent version. If the membranes were ruptured at the time the case entered the hospital, as in this case, a bag placed in the uterus would hasten complete dilatation of the cervix and hence save some time in case delivery became imperative on short notice. Version and extraction should be done when the cervix is completely dilated.

SUMMARY

These cases are very rare.

They are difficult to diagnose by physical examination.

They can be easily diagnosed in the late months by roentgenograms.

They should be diagnosed and corrected early; i.e., in the seventh month if possible and failing in that should receive special care at the time in labor.

TECHNIQUE OF AND OBSERVATIONS ON THE OPERATION OF VASO-PUNCTURE AND MEDICATION FOR SEMINAL VESICULITIS[1]

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IT is undoubtedly universally admitted in urological circles today that the treatment of seminal vesiculitis or spermatocystitis is the most discussed subject in genito-urinary surgery. Unfortunately, but naturally, different opinions are entertained as to the most appropriate method of procedure in any given case. This disagreement is attributable to three causes: first, certain operators are partial to their own suggestions respecting operative procedures; second, many overconservative practitioners, specialists and others, have not yet been sufficiently convinced that surgical attacks on the seminal vesicles are indicated; and third, a number through ignorance or lack of surgical skill decry, *a priori*, surgical procedures.

Variable as may be the views of urologists as to the particular form of treatment in inflammatory disease of the seminal vesicles, they are at least unified in belief that these small structures, too often overlooked if not forgotten by the general practitioner, are very commonly foci for local and systemic affections of the first magnitude. Therefore, it devolves, logically, upon our specialty to blaze the trail for and educate not only the general practitioner, but the general surgeon, the internist, the orthopedist, the neurologist, and the psychiatrist, to the fact that too often they are engaged in the treatment of patients masquerading under a retinue of vague and remote symptoms, the cause of which is little suspected.

Although inflammation of the seminal vesicles was known to Morgagni in 1745, their diseases extensively described by Guelliot in 1883, their perineal incision and drainage first done by Lloyd in 1888 and their removal first accomplished by Ullmann in 1890, it remained for Fuller and Belfield, above all others, to popularize and place the surgical treatment of gonorrhœal spermatocystitis on a practical basis. To these pioneers for their unsullied convictions in the value of vesiculotomy and vasostomy, the profession and humanity at large owe a debt of perennial gratitude.[2]

The subject of this paper is one to which the author has previously given some consideration. At this time it is desired simply (1) to point out certain anatomical features not previously mentioned, (2) to describe and illustrate in greater detail the operation of *vasopuncture and medication for spermatocystitis*, (3) to note the results to date following this surgical procedure.

Anatomical considerations. There are certain anatomical features characterizing the vesiculæ seminales, including the ampullæ of the vasa deferentia and the ejaculatory ducts, that must be thoroughly comprehended before a proper conception can be formed of the true nature, extent, and gravity of inflammation located in these structures or before any adequate treatment can be applied. They may well be styled the male fallopian tubes, not only because Fallopius was the first to describe them, but also and particularly because of the extreme and almost equal difficulty in eradicating resident inflammatory disease, as compared with homologous inflammation located in the uterine adnexa.

The anatomical relationship of the seminal vesicles (Figs. 1 and 2), to the peritoneum, bladder, ureters, prostate and rectum, explaining a composite symptom-complex, when the seat of inflammation, needs no description before this audience. Moreover, all authors have treated this phase of the subject religiously, realizing its importance not only symptomatically, but also with respect to treatment in view of drainage or removal of these organs. Respecting the anatomical configuration of the vesicles themselves in

[2] Space forbids that allusion be made individually in this article to all the authors who have studied and written on this subject. However a rather complete bibliography is appended, which may prove serviceable to the reader.

[1] Read before the American Urological Association, St. Louis, April 17–19, 1916.

Fig. 1. Observe the intimate association of the seminal vesicles to the bladder and ureters, explaining the reason for interference with ureteral drainage when the vesicles become distended with pus, also the bladder symptoms of irritability and retention in periseminal vesiculitis with infiltration of the bladder-wall. Note the poor drainage afforded by the interior anatomy of the vesicle.

Fig. 2. Patient never had venereal disease. Seminal vesicles normal; had seminal colliculectomy for fibroma one month prior to collargolograms. Note tortuosities of vasa deferentia. Observe radiographic catheters in ureters and relationship of same to vesiculæ seminales.

their relation to the clinical features of spermatocystitis, the work of Picker stands as a classic, subject, however, to modifications dependent upon future revelations so far as observations on the living subject are concerned.

Suffice it to say that the seminal vesicle divested of its closely adherent surrounding fibrous tissue is a tortuous blind duct with diverticula, varying in length from 6 to 28 centimeters and in capacity from 3 to 11.5 cubic centimeters. The terminal end of the duct ends in a return curve or hook-like projection: the tubular diverticula, numbering four to eight or more, branch from the main duct at various angles and in different directions, adding to the complexity of the lumen by their own tortuosities (Piersol). Invested in its capsule normally the organ usually measures from 4 to 5 centimeters in length by 2 centimeters in breadth and 1 centimeter in thickness. On cross-section the vesicle presents an irregular, constricted, and sacculated lumen, marked by fine ridges and pits (Figs. 1 and 3), although a histological section portrays to better advantage the delicate cryptic interior (Fig. 4). Whether or not, in addition to this honeycombed condition of the interior, the mucosa also possesses glands is still a disputed question, with the evidence, in my opinion, strongly in favor of the negative. Presumably in the past, the small mucosal pits were mistaken for glands. The lining of these crypts, a single or imperfect double layer of low columnar epithelium, is unquestionably the same as that of the adjacent parts of the lumen, although manifesting secretory activity, indicated by the number of goblet-cells present, concerned in the production of the well known peculiar fluid identified with these structures. The point at issue is that these minute diverticula permeating the epithelium are capable of harboring infection equally as well as true glands.

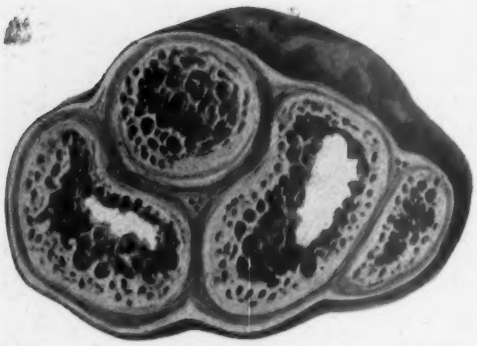

Fig. 3. Cross section of seminal vesicle. The interior network of cellules or crypts completely lining the diverticula of the vesicle, render thorough evacuation of loculated abscesses, as by vesiculotomy, a matter of doubt even though multiple incisions be employed.

The question naturally arises whether the inflammatory products can best be eliminated from these miliary caverns by the scalpel, medication, or massage. The orifice of the vesicular duct at its junction with the vas deferens is large in comparison with the lumen of the ejaculatory duct below, thus facilitating the filling of the vesicle with any temporary content of the ampulla, before it becomes propelled into the ejaculatory duct. This point should be thoroughly appreciated, and if so may assist in appreciation of the rationale of seminal vesicle medication for the cure of inflammation of these structures.

Fig. 4. Photomicrograph of seminal vesicle displaying fine reticulated interior anatomy. *L*, Lumina of diverticula of vesicle.

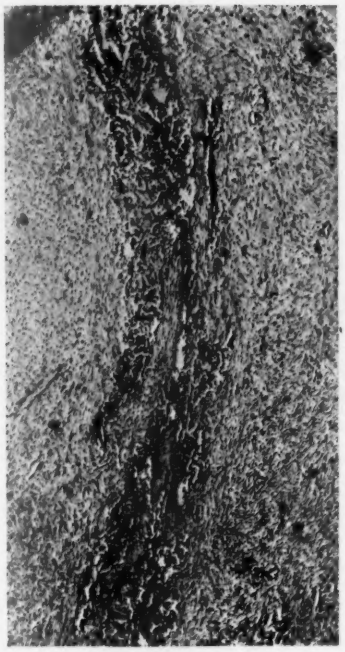

Fig. 5. Photomicrograph of longitudinal section of the ampulla of the vas. Observe the ramifying fine diverticula differing only in degree from the interior anatomy of the vesicle.

Developed similarly from the cavity of the wolffian duct, the ampullæ of the vasa deferentia must receive serious consideration if we are to study, properly, inflammatory disease of the organs in this more or less inaccessible anatomical region. It will be remembered that the ampulla is a tortuous, sacculated canal, possessing diverticula and a honeycombed interior, differing only in degree from the anatomy of the spermatic vesicle (Fig. 5). Invested of its fibrous tissue, it measures 3 to 4 centimeters in length and 7 to 10 millimeters in its greatest width (Piersol). Undoubtedly the finer alveolar anatomical structure of both seminal vesicle and ampulla can be better realized by roentgenographic study (Figs. 6 and 7).

Fig. 6. Chronic seminal pyovesiculosis. Fifty minims of 10 per cent collargol injected into each side.

Fig. 7. Chronic seminal vesiculitis (bilateral). Eighty minims of 10 per cent collargol injected on right side and seventy on the left. Note very large ampullæ of vasa deferentia and courses of the latter on both sides.

The third consideration of importance relative to the drainage of the spermatic tract is the anatomy of the ejaculatory duct, particularly certain diverticula and the presence and activity of the sphincter spermaticus. The upper segment, about 3 centimeters in length, corresponds to a double passage: one, the continuation of the vas and the other, the vesicular duct, resulting by their union in the so-called ejaculatory sinus (Felix). Distally from the sinus, the duct proper becomes the site of five or more appendicular structures (Weisz), obviously capable of harboring latent infection. Thereafter, the course of the ejaculatory duct remains fairly straight coursing through the prostate, where its wall exhibits an intimate connection with the fibrous, muscular, and glandular tissue of the prostate (Porosz), (Fig. 8), lying in relationship to the median and posterior lobes. Coursing almost parallel with the urethra the duct suddenly bends upward to penetrate the urethra. At this level the walls suddenly become thicker, exhibiting many involuntary muscle-fibers, and in the connective tissue can be seen a few red stripes (Van Gieson's stain), marking the beginning of the sphincter (Fig. 8). This portion of the duct is 3 to 5 millimeters in length and its lumen measures about 1.5 millimeters in diameter. The ducts, one on either side, after piercing the urethral wall assume marked curvatures, diverging about the utriculus with an angular deflection of about 90 degrees, and coursing upward through the colliculus and then at the level of their orifices again bend with the result

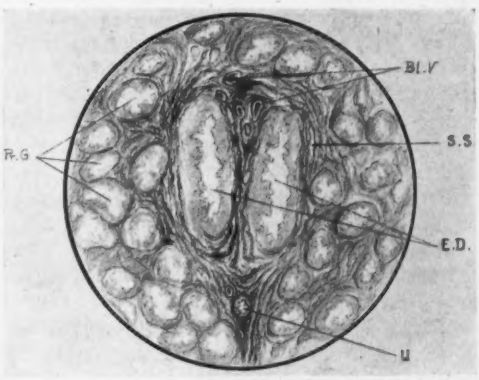

Fig. 8. Showing the relationship of the ejaculatory ducts, surrounded by the fibers of the sphincter spermaticus, to the prostatic tissue. *E.D.* ejaculatory ducts, *S.S.* sphincter, spermaticus, *Pr. G.* acini of prostate gland, *U.* utriculus, *B.V.* blood-vessels. (Modified from Porosz.)

Fig. 9. This series of radiographic prints was taken during the injection of the seminal vesicle with 20 per cent silver protein. The results after injections of 1, 2, 3, 4, and 5 cubic centimeters respectively of the silver solution are clearly depicted. It is difficult to detect much difference between 2 and 3, although in the latter the shadow seems denser. Certainly after the injection of 3 cubic centimeters of the solution, the vesicle, judged by the character of the shadows in 3 and 4, seems to have been thoroughly distended and medicated, hence the futility of injecting more than 3 cubic centimeters of solution. Moreover, a larger amount can readily overdistend the visicle and stimulate its musculature to contract, thereby emptying its content and losing the full medicinal value of the injection. (Skiagrams taken through the courtesy of Dr. H. K. Pancoast.)

that their openings on the declivity, rather than the sides of the colliculus, appear other than slit-like, contrary to the assertions of Mihalkovics (Porosz). Moreover, the ducts rarely may unite within the colliculus and empty into the urethra through a common opening, and although it occasionally occurs that they may open into the utriculus, it has been my experience, urethroscopically, never to have seen their orifices other than around and external to the utriculus. It must be obvious from what has been stated concerning the finer anatomy of the vesicles, ampullæ, and ejaculatory ducts, that the spermatic tract comprises a very extensive and cryptic mucosa to harbor infection, and is at the same time characterized by possessing the worst natural drainage of any anatomical human structure. To devise ways and means to facilitate this drainage and to eradicate infection from this much neglected and overburdened tract is the privilege and duty of genito-urinary surgeons today.

The importance of these observations lies in the fact that, by virtue of the arrangement of the muscle-fibers of the prostate about the ejaculatory ducts as illustrated especially in Fig. 8, with each contraction of the prostate there may occur also a closure of the sphincter spermaticus, thereby demonstrating a very close anatomical relationship between these structures not only physiologically but also pathologically in view of the frequent occurrence of prostatitis. Normally, therefore, the sphincter spermaticus is that sphincter having its origin at the curvature of the ejaculatory ducts, preventing the aimless emptying of the semen from the seminal vesicles as well as from the vasa deferentia. It performs this function through its fixed tonus, just as other sphincters of the body, for example the rectal and urinary, are in a constant state of function (Porosz).

Thus, since the evacuation of the seminal vesicles, just as the urinary bladder is dependent in part at least on their volumetric content at times, this fact is to be borne in mind in the medication of these structures by vasopuncture, vasotomy, or vasostomy, otherwise if overdistended they will be immediately stimulated to empty themselves and much of the medicinal application will be in vain, a misfortune possibly to be avoided by the injection of a smaller quantity, thereby not overcoming the fixed tonus of the spermatic sphincter.

In view of the vague, remote and diverse neurological manifestations masquerading with seminal vesiculitis as their cause, attention must be called to the extensive, intricate,

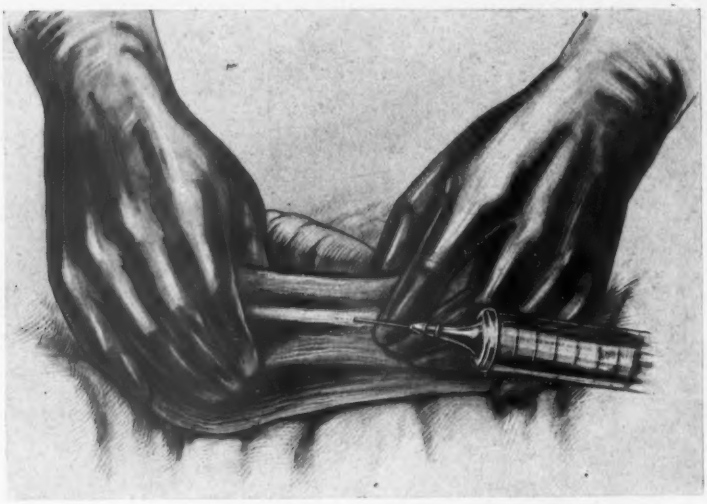

Fig. 10. Presentation of vas in properly held scrotum for infiltrational anæsthesia.

and delicate nerves supplying the spermatic tract. Both pale and medullated fibers, from the hypogastric plexus of the sympathetic system, constitute the deferential plexus and their filaments penetrate to both the muscular and mucous coats (Sclavunos, Timofeew). The nerves supplying the vesicles are even more numerous and have their derivation in part directly from the hypogastric plexus or as secondary plexuses following the hæmorrhoidal and vesical arteries (Frænkel). Thus, in this ordinarily obscure disease, owing to the correlation of the pelvic, prostatic and vesical with the hypogastric, lumbar, and sacral nerve plexus, the presence of pains referred to the back, lumbar, hypogastric, anal, and perineal regions, also the hip-joint and sacro-iliac synchondroses and the thighs, becomes readily explainable.

Treatment of seminal vesiculitis. Space forbids and, moreover, the purpose of this paper is not to present, a detailed description of the various methods, conservative and radical, concerned in the treatment of seminal vesiculitis. Although my present intention is to describe more in detail the technique of an operative procedure — *vasopuncture and medication for seminal vesiculitis* — which was briefly described two years ago, I wish it emphatically understood that I do not regard the operation, *per se*, as a "cure-all" for the majority of patients afflicted with this intractable disease. Indeed, I fully appreciate the fact that there are a number of cases, and have so treated them, in which vesiculotomy, vesiculectomy, vasostomy, or even vasotomy are primarily indicated, and with whom vasopuncture and vesicular medication would avail naught. Obviously vasopuncture, and for that matter also vasotomy and vasostomy are contra-indicated in patients having strictures of the spermatic duct, save for diagnostic purposes. Certainly, in cases exhibiting a marked seminal pyovesiculosis or extensive perivesiculitis, endovesical medication is likely to prove futile. Indeed, in the latter condition, particularly those causing fibroid induration of the base and neck of the bladder with vesical obstruction and retention of urine as recently described by Belfield and frequently observed by the author, vesiculectomy is doubtless the preferable operative procedure. On the other hand, in cases where the vesicles are essentially loculated abscesses, vesiculotomy possesses great merit, *if all the collections of pus are opened.* I would raise a warning hand, however, to the effect that vesiculotomy is

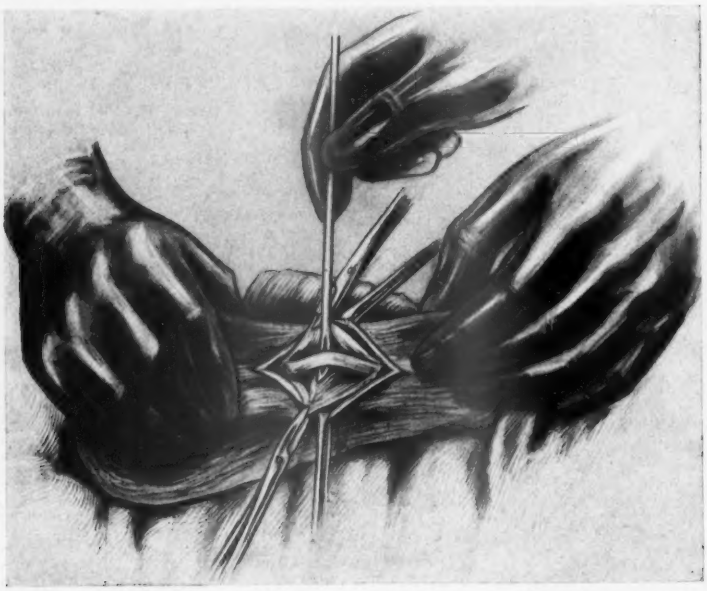

Fig. 11. Isolation of vas from fascial coverings on flat curved end of probe.

Fig. 12. Substitution of grooved director for probe and divestment of vas of its most intimate fascial sheath. Greater freedom secured by pushing back fasciæ with hæmostat.

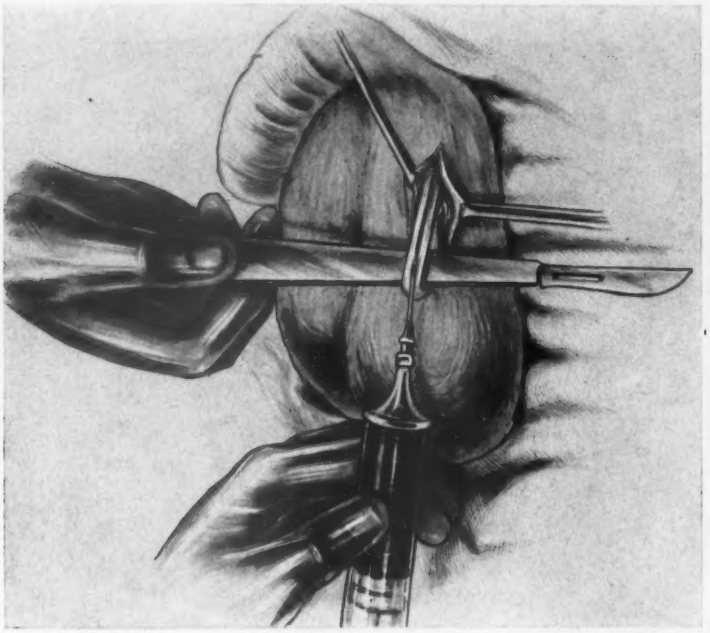

Fig. 13. Vas put on stretch over handle of scalpel preparatory to insertion of needle of syringe and injection of medicating fluid.

not always a curative procedure, also that it is not always well or properly done, indeed in many cases impossible of perfect accomplishment. Moreover, I am confident that many patients are subjected to the operation when it is not strictly indicated, and who could have been just as well, if not better, treated by less formidable measures. I have repeatedly observed vesiculotomies performed on patients in whom as good if not better results could have been obtained by appropriate massage, vasopuncture, and medication of the vesicles, associated with or without autogenous bacterintherapy.

Doubt has been expressed that massage, time-honored and universally practiced in the treatment of subacute and chronic prostatitis and seminal vesiculitis, is of value *per se*. Too vigorous massage, unquestionably, may be harmful. Carefully and properly applied it commonly results in relief of symptoms in certain types of cases, just as in medication of the vesicles, when, aside from the germicidal value of the drug, there occurs a mild intravesicular reaction, which upon subsidence apparently results in eradication of the latent infection.

Impartial thought relative to the treatment of seminal vesiculitis is bound to raise in the mind of the conscientious surgeon a number of pertinent questions. (1) Is it possible, in view of the anatomical considerations herein presented, by vesiculotomy to drain every focal abscess in the infected spermatic tract, especially if the incision is made in the dark or by the sense of touch? (2) If possible, *is it done* routinely, or does the operation afford only partial cure, leaving behind a number of infective foci to perpetu-

Fig. 14. Record syringe equipped with bayonet attached needle, employed for injection of vas and vesicle.

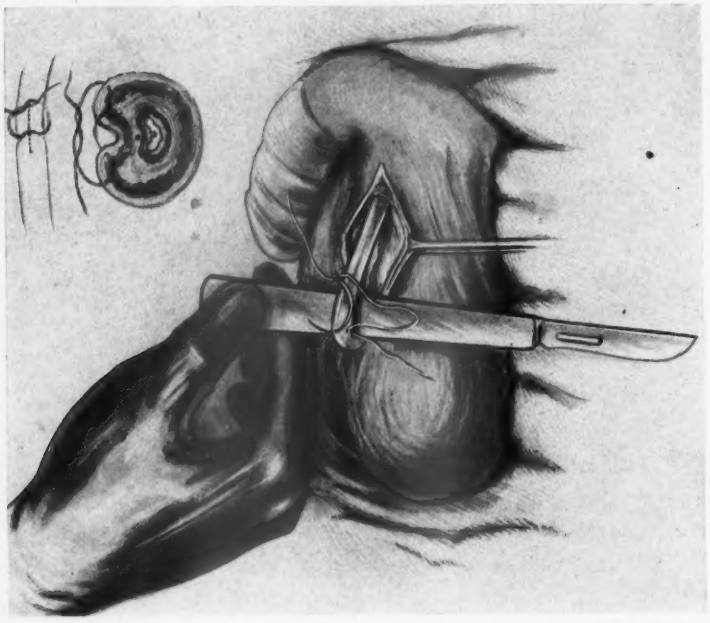

Fig. 15. Introduction of fine plain catgut suture of vas to occlude path of needle puncture, thereby preventing backflow of injected silver solution. Observe diagrammatic drawings.

ate the chronic inflammatory process in a latent form? (3) Granted that a prostatitis is commonly associated with seminal vesiculitis, is it logical simply to drain the vesicles and ignore the infected prostate? (4) Since the male vesicle is the homologue of the pus tube in the female, is it correct and proper merely to attempt to drain the one and insist on the removal of the other? (5) Would it not be a better surgical procedure, attended with better results, when radical intervention becomes necessary, to do vesiculectomy by either the perineal or ischiorectal routes? (6) Are the operations of vesiculotomy and vesiculectomy absolutely harmless in comparison with other procedures of less severity, applicable to many cases and capable of equally beneficial results? (7) In view of the intricate anatomy is it not possible to reach every recess of the vesicle, ampulla, and duct more effectively with a bacteriocidal fluid than with a bistoury? The filling of the various recesses of the vesicle, during injection of the vas, can be well demonstrated skiagraphically (Fig. 9). It will be noted that the vesicle fills from the bottom up, that insufficient protein silver appeared in the vas to cast a shadow until after the vesicle was

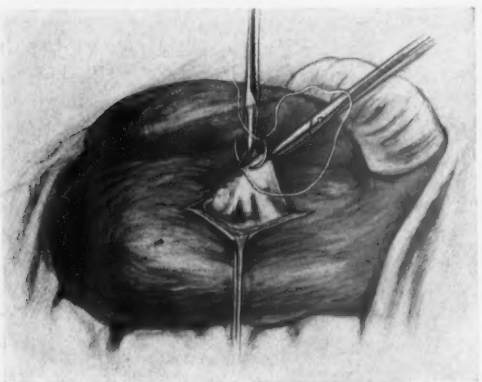

Fig. 16. Closure of fascia with continuous suture of fine plain catgut.

Fig. 17. Closure of skin with continuous suture of chromic catgut.

nearly filled, that no intensity occurred in the vesicular shadow after 3 cubic centimeters had been injected and that there was no escape of the silver solution from the in-lying urethral catheter until after the vesicle was filled. (8) What is the danger of adding to the infection in the seminal vesicle from the operations of vasotomy and vasostomy? (9) Do these operations ever result in stricture of the vas deferens? (10) Is the postoperative funiculitis incident to the regurgitation of various silver preparations injected into the vas in vasotomy and vasostomy, as it is usually performed, not a considerable matter, greatly discounting the utility of these operations? (11) Finally, is it not an excellent surgical principle to utilize and rely on minor procedures until they have been proved to be inadequate, adopting major practices, not routinely, but only in selected cases?

Technique of vasopuncture and spermatocystic medication. The patient should take a cathartic the night before the operation. Immediately before undertaking the operation, the seminal vesicles should be massaged and emptied of any contained inflammatory products. The operation may be conducted as an office procedure, although it is advisable to carry it out either at the home of the patient or in a hospital where he can remain quietly in bed for two or three days, thereby avoiding movements that may provoke the vesicle unduly to contract and expel its medicinal content. The scrotum should be, but may not be shaved, since it is sufficient after thorough antisepsis merely to clip the hairs short at the operative site.

1. A good assistant isolates, holds, and properly fixes the vas in the neck of the scrotum, while the operator infiltrates the overlying skin with a $\frac{1}{10}$ per cent cocaine or a 1 per cent novocaine solution in suprarenin 1:300,000 (Fig. 10).

2. A longitudinal incision about 2½ centimeters in length is made through the skin and fascial sheaths, everting these with Allis forceps and hæmostats respectively, and the vas isolated and brought out of the wound on the curved flat end of a probe (Fig. 11).

3. The probe is substituted by a grooved director and particular care exercised to free the vas of its most intimate fascial investment, thereby facilitating the introduction of the needle: at the same time the vas is stripped of its fascial attachments for a short distance (Fig. 12).

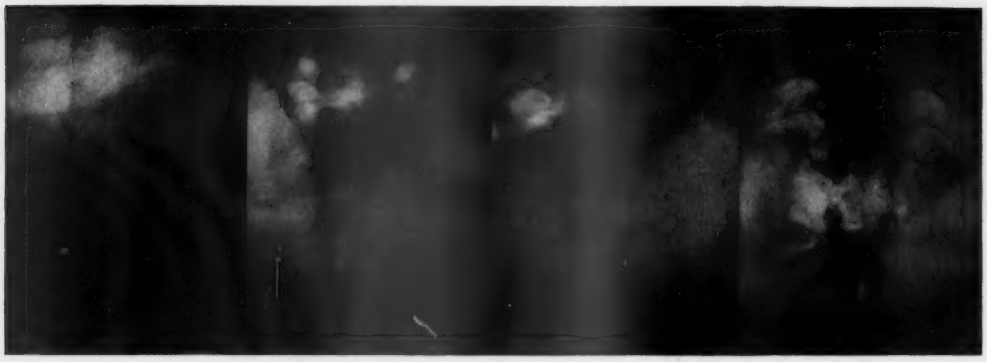

Fig. 18. The above series of radiographic prints represents the shadows cast by the protein silver contained in the seminal vesicles, one, two, three, and four days after vasopuncture and spermatocystic medication. (Skiagrams taken through the courtesy of Dr. H. K. Pancoast.)

4. The handle of the scalpel is now slipped through the loop of the vas and slight traction made (Fig. 13), as the needle of the special Record syringe (Fig. 14) is cautiously introduced at the level of the edge of the handle of the scalpel as illustrated. About 2 or 3 cubic centimeters of sterile water contained in the syringe are first injected to determine the potency of the vas, or better a solution of methylene blue employed, when, with a catheter placed in the posterior urethra, the condition of the ejaculatory duct can likewise be determined. Should a stricture of the vas be detected, no injection of a medicating solution should be attempted, since the fluid is sure to back-flow through the path of the needle puncture and infiltrate the cord, causing a disagreeable funiculitis and epididymitis. In the absence of any obstruction, the syringe is filled with protein, colloidal or other silver preparation and from 3 to 5 cubic centimeters of the solution slowly injected.

5. As the needle is withdrawn, pressure by gauze prevents back-flow, and subsequent regurgitation and extravasation into the spermatic cord is prevented by the introduction of a very fine plain cat-gut suture through the outermost coat of the vas (Fig. 15). *This suture is of the utmost importance and properly introduced effectually prevents any leakage of silver solution through the path of the needle puncture, which will otherwise invade the structures of the cord resulting in a painful, persistent and unwarranted chemical funiculitis.*

6. The vas is then dropped and the fascia closed with a continuous fine suture of plain cat-gut (Fig. 16).

7. The skin is closed with a continuous suture of chromic catgut (Fig. 17): the incision touched with Whitehead's varnish; and a dry gauze dressing applied, supplemented by a suspensory bandage.

Results of treatment. Appreciating the chronic and deep-seated character of the infection in many of these cases of seminal vesiculitis, it is obvious that an immediate brilliant cure following the operation of *vasopuncture and spermatocystic medication*, as with any other therapeutic agent, is to be expected in only a minority of patients. Nevertheless, the marked improvement in the great majority, over and above that obtainable by massage and bacterin therapy alone or conjointly, has been truly gratifying, and although insufficient research has been carried out with the application of this treatment in chronic, subacute, and even acute cases, I am optimistic in the belief that it may enjoy a routine place in treatment of these types of cases. An analogy is exemplified in renal lavage and medication for pyelitis, the utility and value of which is unquestionable in certain cases.

Indicative of therapeutic effect, following vasopuncture and injection of the vesicle with

collargol, the urine appears black or dark brown for a couple of days and shows, macroscopically by its rusty color the presence of colloidal silver for about a week: the persistence of the silver content in the vesicle may also be shown skiagraphically, as can be seen in Fig. 18, taken on consecutive days following vasopuncture and spermatocystic medication: microscopically, after massage brown crystals of the drug have been discovered from two to four weeks after the operation. Thus my own experience dictates the superiority of vasopuncture over vasotomy or vasostomy, the latter being attended with definite disadvantages; moreover, if necessary, it is a simple matter to repeat puncture of the vas.

The thought naturally arises as to whether or not there are any dangers attendant upon *vasopuncture and medication*. The only possibilities worthy of consideration are sterility incident to a chemical epididymitis, stricture of the vas and incarceration of an irritating chemical solution within the spermatic tract owing to stricture of the ejaculatory duct. I can only say that in an extensive, although limited series of cases, I have never observed either of the first two misfortunes, and the latter can easily be obviated by the observance of proper technique. The danger of funiculitis from chemical invasion of the cord, unavoidable in Belfield's vasotomy, is not a consideration in vasopuncture, if the technique be perfect.

I have utilized various silver preparations, chiefly a 10 per cent collargol solution owing to my interest primarily in studying, skiagraphically, the living pathology of the seminal vesicles. Therapeutically, I am inclined to believe that a 5 per cent solution is equally efficient and possibly less irritating. Among other preparations employed may be mentioned protargol ½ to 1 per cent, silver nitrate 1 to 2 per cent, emulsion of argentic iodide 5 per cent, argyrol 10 per cent, and a new preparation of silver protein 20 per cent. This last is a product of the Hare Chemical Laboratory of the University of Pennsylvania and has been found to contain 40 per cent metallic silver, is quite penetrating, unirritating to mucous membranes even in 70 per cent strength, and is inexpensive comparatively with collargol.

Specialists in genito-urinary surgery are only too well aware of the great multitude of patients, who in spite of well-executed massage, for months, indeed for years, persist in exhibiting an abnormal number of pus-cells in the urine containing expressed spermatic contents. These are the patients in the author's experience on whom *vasopuncture and medication* is expressly indicated and its performance at this time may prevent the occurrence of a pyovesiculosis and render, for the future, vesiculotomy or vesiculectomy unnecessary. Although chiefly indicated in subacute also probably chronic and possibly acute catarrhal spermatocystitis, rather than in interstitial or periseminal vesiculitis, I have, nevertheless, observed that in a number of cases of chronic pyovesiculosis, some the victims of a recurrent epididymitis, others complaining of urinary, vesical, urethral, genital, nervous and mental disturbances, many afflicted with arthritic and so-called rheumatic pains and one exhibiting a constitutional disorder manifested by a typical gonorrhœal roseola, vasopuncture and vesicular medication sufficed to produce at least a *symptomatic cure*. I do not believe that in all patients sufficient time has elapsed to guard against recurrences or to state definitely that the local infection has been permanently eradicated. With many microscopical pictures of spermatic content urine, although frequently the field is simply loaded with pus-cells, after medication of the vesicles a normal appearance is not infrequently observed. These results have been obtained in a number of cases a month or two after operation, in the absence of any supplementary treatment whatsoever, although in the majority, if after a few weeks the microscopical test be repeated and an excessive number of pus-cells be found, a certain amount of massage and even repetition of the *vasopuncture and medication* should be practiced.

In a careful analytical study of 94 cases of seminal vesiculitis, most of which were typified by the chronic form of the disease, in 69.2 per cent satisfactory treatment was accomplished by massage and irrigations,

TABLE OF ANALYSIS OF SPERMATOCYSTITIS SUBJECTED TO VASOPUNCTURE AND MEDICATION

No.	Name	Complications	Duration	Attacks of Gonorrhœa	Uni.	Bi.	Number Cells to Microscopic Field Before Vasopuncture	Number Cells to Microscopic Field After Vasopuncture	Massage Necessary After Operation	Time Since Operation	Result
1	R. B.	Perineal pain	4 yrs.	2		+	6	0	No	2½ yrs.	Cured
2	H. T. W.	Perineal burning	3 yrs.	1		+	40	2	No	2½ yrs.	Cured
3	E. U.	Perineal and vesical pains	2 yrs.	1		+	10	(1) 1–2 (2) 2–3	Yes	2 yrs.	Improved
4	E. I. B.	Gonorrhœal roseola	7 yrs.	4		+	?	Loaded	Yes	1 yr.	Improved
5	E. B. M.		6 mos.	1	?	?	25	6	No	3 mos.	Cured
6	W. G. G.	Tabes dorsalis	12 yrs.	1		+	4	1–2	No	4 mos.	Cured
7	E. J.	Perineal and rectal pains	6 yrs.	2		+	6	2	No	1 mo.	Improved
8	P. J. K.	Lumbar pain	2 yrs.	1		+	8	2	Yes	1 yr.	Cured
9	L. F.		2 yrs.	1	+		7	1	Yes	8 mos.	Cured
10	A. C.	Spermatorrhœa	4 yrs.	1	?		0–1	0	No	9 mos.	Cured
11	T. B.	Stricture of vas Epididymitis	14 mos.	1	+		Loaded	Loaded	Yes	6 wks.	Nil
12	G. A. W.		8 mos.	1		+?	?	6	Yes	1 yr. 5 mos.	Improved
13	E. B. T.	Stricture of vas Epididymitis	3 mos.	1	+		8	?	?	1 yr. 3 mos.	Nil
14	C. S. F.		6½ yrs.	2		+	14	2	No	3 mos.	Cured
15	R. W. O.	Epididymitis	5 mos.	1	+		Many	5	No	2 mos.	Cured
16	D. D. S.	Stricture of vas	7½ mos.	1			15	2	No	1 mo.	Cured
17	H. H. W.		3 mos.	1		+	25	Many	Yes	2½ mos.	Nil
18	H. P. M.	Epididymitis	7 mos.	1		+	20	3	Yes	10 wks.	Cured
19	T. W. McD.		3 mos.	1	+		35	?	Yes	4 mos.	Improved
20	G.		?	?		+	?	?	Yes	?	Improved
21	J. B. B.		10 mos.	1		+	7	8–10	Yes	1 yr.	Improved
22	A. A.	Epididymitis	3 yrs.	2		+			Yes	2 wks.	Improved
23	J. C.	Epididymitis	3 mos.	1		+	50	17	Yes	5 wks.	Improved
24	E. A.		5 mos.	1		+	?	40	Yes	1 mo.	Improved
25	T. M.		2 mos.	1	+		13	2	Yes	2 mos.	Improved
26	R. S.		3 yrs.	3		+	?	?	Yes	1 mo.	Improved
27	C. J.	Stricture of vas Impotence	3 yrs.	3		+	?	?	Yes	2 yrs.	Improved
28	W. M. H.		10 yrs.	4		+	7+clumps	0–1	No	1 yr.	Cured
29	A. L.	Epididymitis	2 yrs.	1		+	Loaded	?	Yes	2 mos.	Improved

supplemented in many cases by the alternation of a good polyvalent gonococcic and autogenous bacterins. Obviously, in those associated with chronic prostatitis and posterior urethritis, massage, urethral dilatation, total irrigations, topical applications, and other instrumentation was carried out when indicated. These 94 cases represented a manifold and far-reaching symptomatology, in order of frequency of occurrence as follows: (1) pain, (2) urinary, (3) epididymitic, (4) arthritic and rheumatic, (5) osteoperiosteitic, (6) nervous and mental, (7) impotent, (8) renal, (9) pleuritic, (10) cutaneous and (11) cardiac. Approximately one-half of all cases had no symptoms directly referable to the seminal vesicles, the diagnosis having been established by rectal palpation, massage and microscopy, in patients presenting themselves on account of a urethral discharge.

In 30.8 per cent of cases (see table), for the data on some of which I wish to thank my

associate, Dr. J. C. Birdsall, the operation of *vasopuncture and spermatocystic medication* was performed with the result of cure in 37.9 per cent, improvement in 52 per cent and no improvement in 10.1 per cent. Furthermore, it is to be borne in mind that in the majority of cases subjected to vasopuncture, massage was practiced for variable periods until the condition of the patient became stationary, that graduated massage was necessary to supplement the vesicular injections in the majority of cases, that the infection was bilateral in three-fourths of the cases, that the disease had endured for two months to twelve years before injection was done, that in some cases vasopuncture and medication must be repeated, that 27 per cent of the operations were in cases complicated by epididymitis, and that 50 per cent of the epididymitides demonstrated a stricture of the vas between the neck of the scrotum and the seminal vesicle.

A review of the study of seminal vesiculitis here presented may justify the following conclusions:

1. This paper, supplementing a previous one on the subject of seminal vesiculitis, is not intended to be the final judgment on the value of spermatocystic medication by vasopuncture, but rather to present certain convictions and deductions to date relative to important anatomical and clinical facts.

2. The technique of the operation of vasopuncture as here described and illustrated appears to obviate certain objections encountered in vasotomy and vasostomy.

3. By virtue of the anatomical nature and relationship of the vesicle, vas, and ejaculatory duct, and in consideration of the fact that when the vesicle is infected, the other two are in a similar state, internal medication of these intricate structures, if practicable and attended with beneficial therapeutic results, appeals strongly as an appropriate method of treatment.

4. The pathological condition present in each individual case should be the determining factor in the selection of the proper form of treatment. Vasopuncture and injection is of service, primarily, in many cases in determining the applicability of more radical procedures as vesiculotomy or vesiculectomy.

5. Owing to the impossibility or at least the impracticability of incising and draining all the infected diverticula or recesses of the vesicle, in the treatment of patients not amenable to massage and medication, a serious thought arises whether or not we should try to perfect a better technique and perform vesiculectomy in many cases in preference to vesiculotomy.

6. Spermatocystic medication is not possible in cases with stricture of the vas between the external ring of the inguinal canal and the seminal vesicle; moreover, it should probably not be employed when the ejaculatory duct is strictured.

7. Vasopuncture and spermatocystic medication apparently offers an important aid, supplementing or preceding massage, in the treatment of seminal vesiculitis, whereby in the experience of the author approximately 40 per cent of patients have been cured, at least symptomatically, and over 50 per cent improved.

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A POINT IN THE DIFFERENTIAL DIAGNOSIS OF PYURIA TOGETHER WITH REMARKS ON LAVAGE OF THE KIDNEY PELVIS[1]

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A SOURCE of difficulty in the differential diagnosis of pyuria is the failure to obtain a flow of urine through the ureteral catheter. In most papers concerned with the diagnosis of ureteral and kidney lesions this trouble receives scant attention; but occasionally, as in a paper by Braasch,[2] the frequency of annoyance from this source is frankly admitted.

To obviate a "dry tap" certain procedures are customary. Above all, the catheter must be examined to insure patency, and ample time must be allowed to overcome reflex anuria. In case urine is temporarily suppressed, stimulation of the kidney secretion —both psychic and organic—is secured through administration of water by mouth.

When urine does not appear within a reasonable period, it is usual to inject a sterile solution through the ureteral catheter. This may yield good results; often it does not. For the past five months I have used another method, the technique for which is herewith described.

If urine is not obtained, the catheter is withdrawn from the ureter, and a second catheter passed. In the event of persistent failure of urinary flow, an empty Luer syringe is applied to the large end of the ureteral catheter which had been used first, and the catheter contents are forced out upon a glass slide. Examination of this material yields a diagnosis in most "dry tap" pus-infection cases. Usually there is considerable stringy mucoid material in addition to other pathological constituents. This procedure has several times clinched a diagnosis when it would otherwise have been impossible, or possible only by exclusion. The frequent help afforded by a microscopic examination of the contents of the plugged catheter is truly noteworthy.

This detail in technique not only yields a diagnosis when other measures fail, but it serves also to emphasize the frequency of obstruction, either partial or complete, of the ureteral lumen. Incidentally it shows the value of the ureteral catheter in the re-establishment of drainage from the kidney. We have here a link in the evidence that recovery from pus infection of the kidney, consequent to pelvic lavage, is chiefly in response to opening the obstructed ureteral channel.

In this connection, I am impelled to briefly express certain views on the question of pelvic lavage.

Irrigation of various infected organs and tissues has been quite generally discarded; we have learned the fallacy of irrigation for peritonitis, also the evil which results from irrigation of wounds.[3] In cultures of uteri removed after curettement I find more growth when preliminary irrigation has been employed than when this is omitted.

Moreover, fluid cannot be instilled into the kidney pelvis without back-pressure into the delicate kidney substance; the danger of pyonephrosis is always present. But a few weeks ago I saw a pyelitis of pregnancy which resulted in pyonephrosis subsequent to careful pelvic lavage. Another case, still more recently irrigated because of occasional pus-cells and moderate numbers of colon bacilli from the left kidney, now presents specimens loaded with pus and bacteria.

In those cases in which drainage fails even after the ureter becomes patent, pelvic lavage enters consideration. In kinks of the ureter, thick pus which will pass only when diluted, pus locked in by friable adhesions, lavage may cure upon occasion. As a rule, however, it must eventually be recognized and admitted that insufficient kidney drainage, persistently present, unrelieved by simple ureteral catheterization, is a condition which demands surgical intervention.

[2] Braasch, W. F. Surg., Gynec. & Obst., 1909, ix, 461.

[3] If there is ever discovered an ideal solution which destroys bacteria without injury of tissues, irrigation may some day prove of benefit.

[1] From the Gynecological Service of St. Lukes Hospital, Chicago.

SUMMARY

1. In pus infections of the kidney, in the event of failure to obtain urine upon ureteral catheterization, diagnosis is often possible through examination of material which plugs the end of the catheter.

2. Kidney infections, curable through pelvic lavage, evidently owe their recovery to dislodgment of material which blocks the lumen of the ureter. Drainage of the occluded ureter can be established through the less dangerous procedure of simple ureteral catheterization. When recovery fails to result after ureter catheterization and persistent employment of medical care, it is not to be anticipated that pelvic lavage will cure; the majority of such cases eventually require surgical relief.

HÆMOSTASIS BY INTERPOSITION OF MUSCLE, FAT, AND FASCIA IN PARENCHYMATOUS ORGANS[1]

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THE purpose of this paper is to report the results of experimental work on the use of these tissues in stopping hæmorrhage in such organs as the kidney and liver, when other forms of hæmostasis are either impossible or undesirable.

We are concerned about two problems: (1) which tissue, muscle, fat, or fascia is the best hæmostatic, and (2) what are the gross and microscopical end-results of such interposition? Does the interposed tissue absorb, become fibrous, degenerate, obstruct blood-capillaries, or allow formation of new blood channels? What, in other words, is its fate?

In splitting operations on the kidney for stone or tumor of the pelvis, or hæmaturia of unknown origin, bullet or stab wounds of the kidney, spleen or liver, or rupture of these organs, tears or large abrasions of the liver in the removal of the gall-bladder, cysts or any other condition in which there is uncontrollable or serious bleeding, the need for an easily and readily obtainable and absorbable, non-foreign hæmostatic is urgent. In search for such an ideal hæmostatic we have discarded all substances such as artificially-prepared-beforehand tissues of the human body or foreign substances such as sea sponges, or other vegetable preparations so often advocated, simply because they are not always and instantly available for use, no matter when or where the occasion demands. A substance, to be ideal, must satisfy these demands, and a substance obtained from the tissues of the patient himself is manifestly the most desirable.[2] In 1911, in an article on hæmostasis in surgery of the brain, Cushing recommends the use of pieces of raw muscle to control annoying hæmorrhage in brain work and speaks of this procedure as not being an unfamiliar one, for apparently he and Horsley had independently come to employ it.[3]

Horsley (3) published a short article in 1914 on the further experimental use of this tissue. He explains the valuable action of muscle tissue on the ground that it possesses above all other tissues three requisites: (1) asepticity, (2) adhesiveness, and (3) thrombokenosis. The thrombokenetic process is stimulated in the tissue to which it is applied, not only on account of the plasma exuding from the cut surface but also because of the thrombokenetic by-products (platelets, etc.) in the effused blood. The factor of adhesiveness is also an important one and it has been found experimentally that a piece of muscle

[2] Even the fibrin advocated by Gray (1) was not considered because of the necessity of its beforehand preparation. We grant, however, that when brain surgery is being done, always in a well-equipped hospital, this may be an ideal hæmostatic for this particular branch of surgery.

[3] The work of Cushing in this particular branch of surgery and his use of muscle as a hæmostatic is too well known to need further mention here. As this paper deals in no way with surgery of the brain no reference is made to papers on this subject.

[1] From the Laboratory of Surgical Research Harvard Medical School.

pressed firmly against wounds in a large vessel, even the aorta in cats, after it has become adherent will resist a pressure of from 60 to 80 millimeters of mercury.

Histologically the line of contact of muscle tissue against bleeding surface shows an excess of blood-platelets and fibrin in considerable degree within 5 to 10 minutes after application. That the value of muscle lies largely in its thrombokenetic contents is shown by the fact that a piece of boiled muscle, in which these elements are altered or destroyed, acts very poorly as a hæmostatic. Fascia and fat also fail to be as efficient because they lack both thrombokenetic elements and adhesiveness.

The rather definite opinion has been expressed by both Horsley and Cushing and others that muscle tissue is undoubtedly by far the most effective hæmostatic of the three tissues under consideration.

From our operative work in the laboratory we believe this opinion should be somewhat modified. We would state that "in general, and probably in the majority of instances, muscle tissue is by far the most effective and rapidly acting hæmostatic when interposed in the bleeding substance of a parenchymatous organ, but, in moderate bleeding and in many cases of tears in the liver even down to spurters, an interposed piece of omentum will often check serious hæmorrhage in a surprisingly rapid manner, and in the kidney the same is true to a lesser extent of both fat and fascia, but more especially of a thin strip of fascia. We can say therefore that muscle is probably the most effective hæmostatic, but fascia and fat will often work just as satisfactorily."

These substances are ideal hæmostatics in that they are always readily and instantly available, are absorbable and interfere in no way with the healing of the tissues. They do not need to be removed later, and wounds in which they are used can often be sewed up tight instead of being packed with gauze, therefore necessitating possible secondary hæmorrhage from later removal of the gauze or the onset of sepsis with delayed convalescence dependent on a drained wound.

We have adopted the following procedure in all not easily controllable hæmorrhages in parenchymatous organs. First control all bleeding as far as possible by a firm gauze pack, while a suitable piece of muscle is being excised for application against the bleeding surface, remove gauze gently, and quickly apply the unwashed muscle to the area, hold it by firm gauze pressure until it becomes adherent and is anchored by a few interrupted stitches, remove gauze pressure gently and slowly. Should bleeding continue use more muscle if the whole bleeding area is not in contact with the first piece of muscle, or overlie the first piece by a layer of fascia sewed down as firmly as possible to hold the muscle implant in place. Sew up with or without rubber tissue drainage as the case indicates.

In cases where it does not seem advisable to sacrifice muscle tissue use first fascia and secondly fat tissue. Whereas muscle tissue need rarely be sewed in place because of its adhesiveness, both fascia and fat must necessarily be sewed over or into the bleeding area as closely as possible. Of course the parenchymatous organs are extremely friable, but we have found that with the use of No. 00 catgut or very fine silk a satisfactory application of these tissues can be made to the bleeding surface and that after a little gauze pressure over the implanted tissue, organization in the interlying blood-clot takes place so rapidly that on removal of the gauze, fascia and often fat tissue will be found quite firmly adherent to the raw area.

The following detailed account of our work will show definitely what method was employed and what can be expected and what the end-results in tissue change were.

Experiment 1. June 24, 1915. Dog. Intratracheal ether anæsthesia. Right kidney delivered through lumbar incision, split to pelvis with rubber-covered clamp on pedicle. Piece of quadratus lumborum muscle 1½x1 inches with some fascia attached, excised and interposed in upper two-thirds of kidney incision. Muscle purposely rather jaggedly cut. Immediate hæmorrhage checked. Muscle anchored to kidney with a few silk sutures. Kidney sewed up with No. 00 catgut. Wound closed without drainage. Moderate hæmaturia for forty-eight hours. Small sinus oozed serum for two weeks, then healed. Animal sacrificed at the end of 88 days. Grossly it was impossible to tell where muscle had

been interposed. There was no bulging or depression over the scar. No signs of sepsis. No adhesions. Microscopically, the muscle tissue of the insert stains rather lightly, is rather fibrous in appearance. There is practically no infiltration with polymorphonuclear leucocytes. Practically no degenerative changes in the kidney, which stains normally except at the line of union of the two tissues where it takes the stain a little less darkly. In places fairly well marked line of demarcation betweeen the kidney and muscle. In other places the ingrowth of connective tissue is such that there is close blending of the two tissues.

Comment. The interposed muscle acted as an effective plug to stop active hæmorrhage and later became adherent to the cut kidney surface by the formation of fine connective tissue. There is evidence of a gradual change of muscle into fibrous tissue not yet complete at this time,— three months. Insert has not been the cause of any degenerative changes in the adjacent kidney tissue.

Experiment 2. June 25, 1915. Dog. Intratracheal ether anæsthesia. Right kidney delivered through vertical lumbar incision. Large wedge-shaped piece excised from upper pole and a similarly sized piece of quadratus lumborum muscle cut and interposed and held in place with a few No. 00 plain gut stitches controlling all hæmorrhage except at very tip of incision where a persistent spurter required another piece of muscle to be placed over it to control bleeding. A layer of fat was then sewed over the line of suture and the kidney returned to its bed practically dry. A small urinary sinus developed on the sixth day but was closed in twelve days. Specimen taken at end of 30 days. Gross specimen showed solidly healed wounds in soft parts and kidney. A very small pea-sized abscess in pelvis of kidney. Line of union of muscle and kidney solid. Very little evidence of operation. Microscopical section: Line of demarcation between two tissues more noticeable than in Dog 1 and more infiltration with leucocytes along line of union. Kidney tissue along line of union takes stain less well. Some slight ingrowth of connective tissue. Muscle more distinct, stains more deeply, and shows fewer fibrous changes. Sutures not encapsulated but their bed surrounded by leucocytes. No degenerative changes in kidney. Section after thirty days apparently shows an earlier stage of the blending process as would be expected. Apparently only beginning fusion between the two tissues. At this stage it would be hard to tell microscopically whether the implant was going to "take" or not. Overlying piece of fat not seen in section.

Comment. Implant of muscle checked hæmorrhage. Seen at stage too early to show ultimate fate of graft. Was definitely adherent to kidney substance. Probably beginning to undergo fibrous changes. No degenerative changes in kidney tissue.

Experiment 3. June 28, 1915. Dog. Intratracheal ether anæsthesia. Right kidney delivered as previously. With a small trephine a ragged bullet wound was simulated, completely puncturing kidney. The hole plugged with muscle and a layer of muscle sewed over the wounds on either side of the kidney. Considerable hæmorrhage until this muscle was well sutured in place. A layer of fat was then sutured over one side to prevent adhesions to a piece of protruding muscle. Rubber-tissue drain sewed into skin. Wound healed July 6, 1915, except small superficial sinus when drain was removed. Animal sacrificed after 84 days. A few adhesions around kidney but none in region of fat patch. There were encrustations along line of suture and dense scar where muscle had filled hole made by trephine. Microscopically, section shows large blood-clot partly fibrous in character especially at its line of junction with kidney tissue. Muscle stains moderately. Considerable infiltration with leucocytes both along line of union and in kidney tissue adjacent to this area. Line of demarcation between two tissues is indistinct and shows more firm organization of blood-clot deeper in wound and more ingrowth of connective tissue into the crushed interspaces of the kidney. Muscle stains fairly well but is becoming fibrous in character and gradually losing its identity as muscle tissue. It has made a firm union with the lacerated kidney tissue, which, however, shows practically no degenerative changes.

Comment. Nearly three months after operation large muscle insert is becoming fibrous in character, has taken the place of the gouged-out kidney tissue, has not apparently interfered with kidney function to any extent and has become firmly incorporated in its new situation.

Experiment 4. June 30, 1915. Dog. Intratracheal ether anæsthesia. High median abdominal incision. A piece of rectus muscle 2.5x1 inch excised and placed in warm salt solution sponge. Liver cut with knife 2.5 inches deep with profuse arterial hæmorrhage. Muscle interposed and held in place with some difficulty (no assistant) by two silk sutures, but hæmorrhage so profuse that wound had to be packed for 10 minutes. Dog nearly exsanguinated. Hæmorrhage practically ceased when sewed up. No drainage. Animal died at the end of 48 hours from inanition. Autopsy showed no further hæmorrhage had taken place after operation. There was fibrin everywhere around operation wound in liver with firm adhesions. Muscle was pale but adherent to liver firmly. No specimen taken as case too recent.

Observation. In order to secure the most prompt and most efficient action of the fibrin forming elements in muscle the edge to be approximated to a bleeding surface must be cut with a knife rather jaggedly and not crushed as with a scissors cut. Also in this case it is evident that some of the thrombokenetic elements were extracted from the muscle by its contact with the salt solution sponge.

Experiment 5. July 1, 1915. Dog. Intratracheal ether anæsthesia. Median incision in upper abdomen. Piece of rectus sheath 1.5x1 inch ex-

cised and placed in warm salt solution sponge wrung out nearly dry. Liver drawn down and held in operative field by mattress suture for traction (no assistant) an oblong piece of liver, size of the fascial transplant excised with knife from upper surface, fascia placed over this area and held in place by four silk sutures one at either corner. Vigorous ooze from denuded surface checked. Wound closed without drain. Autopsy after 14 days showed clean smooth surface where patch had been placed on liver. No signs of further hæmorrhage or of sepsis.

Comment. Fascial insert checked immediate hæmorrhage, had become well attached to liver surface, had not been absorbed, and acted as an efficient hæmostatic.

Experiment 6. July 2, 1915. Dog. Intratracheal ether anæsthesia. A 1.5 inch square piece of liver surface excised; with profuse hæmorrhage, ragged piece of left rectus excised and sewed with four stay sutures of silk to raw liver surface. Bleeding stopped immediately and before wound was closed, muscle seemed to be well adherent to liver surface. Animal died of pneumonia on sixth day. Autopsy showed omentum adherent just below line of suture on liver, no signs of peritonitis. Site of operation covered with pale white layer of fibrin. Transplanted muscle soft, rather pale, and firmly adherent to raw surface of liver. Microscopical section shows muscle intact, stains deeply and lies over small blood-clot which in places is becoming fibrous. No signs of fibrous degeneration in muscle or ingrowth into liver. Liver shows intense leucocytic infiltration. Organization of blood-clot firmly holding muscle to liver surface. Fibrous changes more marked on liver side of blood-clot than on muscle side. Torn blood-vessel walls shown. Suture not encrusted. Specimen too early to show definite fibrous changes. Small portion of a second section shows muscle in close contact with liver substance with fine fibrous changes and close adhesion of two tissues.

Comment. Muscle in early stage of implant is still intact, shows few fibrous changes. Acted as efficient hæmostatic on liver surface, stopping immediate hæmorrhage, but section taken too early (6 days) to show other changes.

Experiment 7. July 7, 1915. Dog. Intratracheal ether anæsthesia. Liver pulled down and torn between fingers deep to active spurters and fat of round ligament held up into depths of tear by one silk stitch. Wound closed in layers with silk. Severe bleeding still present while sewing up. No drainage. Dog died under ether at a second operation on kidney nineteen days later. Autopsy showed no further hæmorrhage, no sepsis, and omentum firmly grown to line of operation. Microscopical section of liver shows very slightly organized overlying thin blood-clot. Fat of insert unchanged except for very slight fibrous change in some areas. No ingrowth of fibrous tissue into liver substance. Section kept too long in alcohol before cutting and is poor. Shows many artifacts.

Comment. The tissue of the round ligament acted as a fair hæmostatic in the torn liver surface, was microscopically adherent, but showed no blending of the tissues or ingrowth. Section nineteen days after operation and marked changes in fat tissue not to be expected at this time.

Experiment 8. July 9, 1915. Very small emaciated mongrel in poor condition from mange. Intratracheal ether anæsthesia. Liver exposed, gallbladder pulled down, easy cholecystectomy, bleeding on liver easily controlled with patch of right rectus muscle held in place by silk sutures. Wound closed in layers without drainage. Autopsy after 48 hours showed plum sized firm clot under site of operation, no free hæmorrhage. Muscle well incorporated in liver sulcus. Omentum well walling off area.

Microscopical section shown unencapsulated suture. Muscle pale and in cross section. Very little hæmorrhage between muscle and liver. Line of union strongly infiltrated with leucocytes. No ingrowth. No change in muscle tissue. Stains deeply.

Comment. Section two days after operation. Too early to show any change except leucocytic infiltration. Muscle easily controlled hæmorrhage at first, but was not held sufficiently long or sewed sufficiently tight in place to act as entire hæmostatic. Faulty technique.

Experiment 9. July 26, 1915. Dog. 1. Intratracheal ether anæsthesia. Liver torn to spurters. Omentum sewed into rent and wound closed without drainage in spite of rather free bleeding. Animal sacrificed after 56 days. Omentum firmly adherent to tissue, some surrounding adhesions. No signs of late hæmorrhage or sepsis. Section. Silk suture well encapsulated in young connective tissue, no calcification. Fat tissue of omentum to a certain extent absorbed and replaced by fine connective tissue. Line of adhesion to torn surface of liver shows many new blood-channels. A moderate infiltration of leucocytes along line of union, which is firm. No degenerative changes in liver.

Comment. Omentum largely replaced by fine connective tissue. Fat absorbed to a considerable extent. No degeneration of liver. Apparently omentum thus inserted forms a serviceable fibrous plug and acts as an efficient hæmostatic.

Experiment 10. July 27, 1915. Dog 3. Intratracheal ether anæsthesia. Difficult cholecystectomy (no assistant). Ragged piece of left rectus forced into cavity with gauze pressure and on removal of gauze a layer of fat from the suspensory ligament was sewed over muscle to hold it in place. Immediate hæmorrhage readily stopped. Animal sacrificed after 55 days. No signs of further hæmorrhage, omentum adherent to site of operation. Scar firm. No signs of sepsis.

Section shows line of demarcation between liver and implant sharp, no blending of tissues. Very slight leucocytic reaction. Implant firm in character. No absorption of liver tissue. Muscle

stains deeply. Fat tissue shows some fibrous changes. Sutures not encapsulated.

Comment. Wedge of muscle apparently acted as efficient hæmostatic without becoming permanently adherent to liver surface and has not become as fibrous as those inserts which have become fused with the surrounding tissue.

Experiment 11. July 22, 1915. Dog 5. Intratracheal ether anæsthesia. Right kidney delivered, split to pelvis, leaf-like strip of fascia interposed and kidney sewed up with mattress sutures. Considerable hæmorrhage before wound closed. Many silk sutures placed along line of incision in kidney and fat laid over suture line. Autopsy after 3 days showed considerable hæmorrhage around kidney, which was probably due in part to tearing of soft parts, as kidney was very adherent and hard to deliver at operation. Line of suture thinly covered with fresh fibrin. Section shows marked leucocytic infiltration, especially at site of injury to kidney. Fibrous tissue of fascia unchanged. Stains strongly. Is closely blended with kidney substance.

Comment. In this case fascia was not as successful in stopping hæmorrhage from a split kidney as was muscle in Experiment 1, but even in the short space of three days it became firmly adherent to kidney surface.

Experiment 12. July 30, 1915. Dog 7. Ether anæsthesia, cone method. Right kidney split to pelvis. Large slice of fat with some fascia interposed but with no checking of bleeding. Even after mattress suture had been placed and tied the kidney bled profusely. Dog etherized with cone and died on table.

Comment. Fat as a hæmostatic in severe hæmorrhage from the kidney is of little value. It is difficult to keep in contact with the bleeding surface and has no fibrin-forming qualities.

CONCLUSIONS

1. The ideal hæmostatic in wounds of parenchymatous organs is interposed muscle tissue taken at the time of operation from the patient's own body.

2. Such muscle in order to most effectively stimulate fibrin formation should be jaggedly cut with a knife and not crushed as with a scissors cut, nor should its hæmostatic properties be extracted by its contact with salt solution.

3. Fascia and fat act to a more limited degree as hæmostatics: fascia more than fat, but both very much less than muscle. In the liver, however, both fascia and fat seem at times to be very efficient hæmostatics.

4. These tissues readily unite to the bleeding surface to which they are sewed and form a smooth, solid scar.

5. Microscopical examination of specimens removed at varying intervals after operation show in our series absence of sepsis, a beginning transformation of muscle into fibrous tissue, a partial absorption of fat and change into fibrous tissue, no change in fascial transplants, in practically every case a firm blending of the interposed tissue with the cut surface of the parenchymatous tissue, the formation of new blood-channels and no degenerative changes of any note.

6. We conclude therefore that muscle, fascia and fat can be safely interposed into these tissues and after acting as immediate hæmostatics later undergo fibrous changes and form a firm union with the parenchymatous tissue.

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THE ADVANTAGE OF PLEURAL EFFUSION IN GIANT HYDATID CYSTS OF THE LIVER

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HYDATID cysts of the liver which develop almost exclusively in the thoracic region are relatively uncommon. The case which I shall report is very interesting because of its rarity and has prompted me to make a few suggestions which I trust will be duly weighed and submitted to clinical study.

M. M., female, age 22, entered the general hospital of Chillan, Chile, December 21, 1915, with a large swelling involving the right side of the thorax, the hypochondrial and epigastric regions. Marked dullness reached upward close to the clavicle and the highest part of the scapula. In the epigastrium, fluctuation could be easily felt. The swelling had commenced several years ago and had been accompanied by only a few disturbances. Loud rales could be heard. The temperature was normal. The findings were normal as evidenced by percussion and auscultation of the left lung. Auscultation of the right lung failed to reveal any vesicular respiration.

On December 30, the patient was operated on under chloroform anæsthesia. A laparotomy incision was made at the outer border of the right rectus. After protecting the peritoneal cavity, we injected a 2 per cent solution of formalin as advocated by Dévi and Franke. By tapping, an enormous quantity of clear fluid (12 liters) was easily withdrawn. The membranes were very thin and not well developed. As soon as the cavity was opened, the air rushed through the wound. After performing the operation and before bandaging the patient, we discovered, both by percussion and auscultation, that the lung had expanded to its normal capacity. Rales became almost inaudible.

A few hours after operation the patient became worse and expectorated an abundant, frothy, pink substance; pulse became weak and fast. Death followed the same afternoon after unsuccessfully injecting camphor and caffeine hypodermatically. Unfortunately, owing to the obsolete and defective hospital regulations, a necropsy was not performed and it was therefore impossible to confirm our diagnosis absolutely. Notwithstanding this fact we believe the clinical diagnosis of acute pulmonary œdema is very probable.

Fluoroscopic examination would have been of great assistance in arriving at a correct understanding of the case.

Because of the enormous size of the cyst, the lung could not perform its function properly, the mediastinum was deviated to the opposite side, the trachea was pressed upon producing rales, and expansion of the left lung was considerably reduced. The sudden and complete drainage of the cyst permitted an equally sudden distention of the collapsed lung and the fatal congestion and œdema which followed were unavoidable. As the heart had been handicapped in its function for so long, it had become weakened and could not strive against the increased strain so suddenly placed upon it. To sum up, the result was identical with that which occurs during or shortly after evacuating a recent pleural effusion.

The cyst, strictly speaking, was not an abdominal one; it could be classified as abdominal only by its point of attachment. Owing to the nature of its development, the pulmonary œdema was a purely thoracic condition requiring identically the same treatment as a pleural effusion. The thoracic dullness which extended to the clavicle and which was totally without thoracic vibrations, we attributed, according to our former experience, to an accompanying effusion which in the above described case would have been of great help in preventing the fatal issue, since it would have checked the sudden distention and consequent œdema of the lung. We are inclined to believe that very likely successful operations on enormous cysts of the liver owe their success to accompanying pleural effusion.

Very little mention, if any, is made as to the presence of pleural fluid in cases of hydatid cysts of the liver, especially when the cysts are found on the convex surface. Dieulafoy has called attention to this fact. The frequency with which pleural fluid is found is explained by the well-known structural connection between pleura and peritoneum.

Pleural effusion would be of paramount importance not only as the explanation of the spreading of the pathological process but as an agent of the utmost significance in the treatment of the original disease; it has been wisely placed by nature to prevent harmful complications after the primary cystic cavity has been opened.

When effusion is not present, how can we supply it and obtain equally beneficial results? If our interpretation be correct it would be perfectly justifiable to induce an artificial

pneumothorax. I shall not hesitate in the future to avail myself of this simple procedure in such cases.

Another useful method would be to begin with fixation of the abdominal muscles and after three or four days to inject formalin and bring about a gradual evacuation, in two or more sittings. This procedure is doubtless safe and methodic but it has the great disadvantage of bringing about secondary cicatrization.

As to which one of these methods preference will be given, the future will decide.

We have consulted the most important works on the subject but have failed to find the least reference to the question. The facts seemed to us to be so simple and their interpretation so easy that we do not hesitate to offer this brief resume in the hope that others who have better opportunities for seeing such cases will report their experience.

I wish to express my thanks to my friend Dr. Anibal Contreras, surgeon to the Woman's Department of the Hospital of Chillan, for the privilege of operating on and reporting this case.

THE SIGNIFICANCE OF BLADDER SYMPTOMS IN THE DIAGNOSIS OF RENAL DISEASE

By A. J. CROWELL, M.D., F.A.C.S., Charlotte, North Carolina

THE relation of the bladder symptoms to renal disease is very similar to that of fever to infection, or gastric symptoms to diseased conditions of the gall-bladder.

No case of so-called chronic cystitis should be so regarded without first having excluded renal infection. Although chronic cystitis in the great majority of cases is due to renal infection, this is by no means its only primary cause. Any bladder, prostatic, or urethral obstruction which prevents the complete elimination of the kidney secretion, is a potent predisposing cause of cystitis. We usually have a chronic cystitis with such conditions; but without urinary obstruction in the male, primary chronic cystitis is of rare occurrence. We have found this quite different in the female. This is probably due to the easy route of ascending infection. Simple cystitis is much more frequent in the female, hence, we have found kidney infection, due to organisms other than tubercle bacilli, much more frequent in the female.

The renal conditions which are most frequently manifested in the bladder, are (1) tuberculosis, (2) pyelitis or pyelonephritis, (3) lithiasis, and (4) neoplasm.

RENAL TUBERCULOSIS

It is safe to regard every case of persistent cystitis with pyuria, and especially in the young, as tuberculosis of the kidney until a thorough investigation shows it to be otherwise. An early recognition of the disease is very important in order that secondary bladder infection, which is very hard to cure, may be avoided. The earlier the diagnosis, the more favorable the prognosis.

Symptoms. Practically every case of renal tuberculosis is manifested in the bladder. These manifestations are much more marked in the male than in the female. Hæmaturia is also less frequent in the female for the same reason, that is, complications interfering with the normal bladder function are more frequently found in the male than in the female. In tuberculosis, profuse, painless, hæmaturia is occasionally seen before the appearance of any bladder symptoms. In such cases the lesion is most certainly in the kidney and without any local kidney manifestations. At such a time, however, firm percussion over the diseased kidney will elicit pain.

The vesical symptoms predominate during the whole course of renal tuberculosis

and especially is this true in the early stages. In fact, in its incipiency, a slight, painless, increasing frequency is the only noticeable symptom. This would not be recognized were it not for its annoyance at night. At such a time urinalysis will show a few pus-cells, an occasional blood-corpuscle, and possibly a trace of albumin. Cystoscopy will show a congested ureteral opening with a few small ulcers about its orifice.

Tubercle bacilli can be found in the bladder urine in probably 80 per cent of all cases of kidney tuberculosis, but to be thorough in our methods, accurate in our diagnosis, and safe in our treatment, the ureters should be catheterized and guinea pigs injected with urine from each kidney. This will determine definitely whether one or both kidneys are tubercular. To remove one kidney when both are diseased would be disastrous.

Recently, Petroff, of Saranac Lake, New York, has described a new medium for the rapid isolation of tubercle bacilli from the sputum and fæces. We are at present engaged in our laboratories in devising a technique for applying this method to the urine. It gives promise of obtaining a positive diagnosis by culture within one to two weeks, whereas the guinea pig test is hardly ever positive in less than three or four weeks. At present, however, we think it best to use a combination of the staining, culture and inoculation methods.

Urological men practically agree that the infection is through the blood and lymphatics; through the blood where there is no obstruction in the lower urinary tract, and through the lymphatics where there is. Sweet and Stewart have shown that the lymphatics between the bladder, ureters, and kidney intimately anastomose and that infection can readily be transmitted through them. This, I believe, is why kidney infection is more frequent in the female than in the male, and especially the pregnant female. It is said to occur in the latter in about 20 per cent of all cases. Here we have the lowered resisting power, the frequent bladder infection and anastomotic lymphatics.

The cystitis, due to organisms other than tubercle bacilli, is less severe than that which occurs with tuberculosis. Clinically, this knowledge is of value in differentiating a simple from a tubercular infection. However, we may have a mixed infection. We should always be suspicious of tuberculosis where we have areas of ulceration in the bladder. In such cases the above combined test for tuberculosis should be used.

We not infrequently have general infection of the kidneys with practically no bladder infection or symptoms. I have recently seen several such cases, but all of long standing. The tissues seem to become accustomed to the presence of the bacteria and as a result they produce only a slight reaction. It is also said that the symptoms produced by hæmatogenous infection are more marked than those due to lymphatic ascent.

PYELITIS OR PYELONEPHRITIS.

These two conditions are so closely associated and their symptoms so similar that we can discuss them as the same condition in so far as the bladder manifestations are concerned. Frequency of urination is present in about 75 per cent of the cases of simple infection, while marked cystitis is found in only about 16 to 18 per cent.

The local kidney symptoms are also less severe in a simple pyelonephritis than in tuberculosis. The bladder symptoms grow less severe in the former and more aggravated in the latter. The proportion of the cases of cystitis resulting from renal infection is greater in the male than in the female. This again is due to the easy elimination in the female. Hæmaturia is present in 40 per cent of the cases of kidney infection. (In hæmaturia due to a simple pelvic infection, nitrate of silver irrigations through the ureteral catheter give wonderful results.)

In addition to the clinical symptoms of pyelonephritis, it is necessary to obtain pus from urine secured by ureteral catheterization in order to make a diagnosis. The amount of pus thus obtained varies in pro-

portion to the activity of the infection. Patients with a sensitive bladder and practically no microscopic findings in the urine will often show bacterial growths from urine obtained by ureteral catheterization.

Bilateral infection occurs in about 70 to 75 per cent of the cases of simple kidney infections. It occurs much more frequently in the right than the left when unilateral.

The activity of a chronic renal infection varies considerably. At times it is almost dormant. In such cases the only symptom noticeable is a slight frequency of urination. Here pyelography is of great advantage as well as the phenolsulphonephthalein test.

Pyelography shows ureteral and kidney pelvic dilatation and differentiates that due to inflammation from that due to back pressure. The phthalein output gives the kidney functional activity. This is in proportion to the extent of parenchyma involvement. In the simple pyelitis, of course, the output will be normal, but in a pyelonephritis it will be diminished in proportion to the extent of the infection. The normal kidney function may be impaired as a result of a chronic parenchyma infection when there is practically no pus in the urine obtained by ureteral catheterization. In such cases a bacteriological examination will disclose not only infection but also the nature of the infection.

LITHIASIS

The clinical picture of lithiasis is so intimately associated with bladder symptoms that a distinct radiographic shadow in the kidney or ureter would hardly be interpreted as that of stone without bladder symptoms. This is certainly true at the beginning of impacted ureteral stone.

Urinalysis may or may not reveal evidences of kidney stone. There is always more or less infection accompanying kidney stone, and, of course, its manifestation in the urine is in proportion to the activity of the infection, the size of the stone, and its location. A stone located in the kidney pelvis will produce greater frequency than when it is located in the kidney parenchyma. Blood and pus are also more constant in the urine when the stone is in the pelvis. Hæmaturia is increased by motion and especially following violent exercise. I believe this is more constant if the stone is in the kidney pelvis.

In addition to the bladder manifestations and the usual clinical tests for kidney stone, the ureteral catheter and X-ray are indispensable if we are to be accurate in our diagnosis.

NEOPLASM

There are practically no bladder manifestations of the kidney neoplasm except hæmaturia and the bladder symptoms accompanying ureteral occlusion with blood clot. Hæmaturia may be profuse, as in papilloma of the kidney pelvis, or it may be so slight as to be detected only by microscopical examination of urine obtained by ureteral catheterization. When the hæmorrhage is profuse, it may be intermittent and accompanied with attacks of colic as well as frequency of urination. These are produced by the ureters becoming occluded with blood-clot.

In hypernephroma about the only symptom complained of is hæmaturia. Here again the ureteral catheter, phthalein output, and X-ray pictures are necessary to make an accurate diagnosis.

CONCLUSIONS

1. Persistent frequence of urination is only a manifestation of a pathological condition somewhere in the genito-urinary tract.

2. Chronic frequency, without urethral obstruction, prostatic or seminal vesicle inflammation means renal disease in practically every case.

3. The bladder manifestations of the various pathological conditions of the kidney are so similar that it is only by a close observation of the clinical symptoms and by the use of the most approved laboratory methods that we are able to differentiate not only between bladder and kidney lesions but also between the various pathological conditions of the kidney.

THE CLINICAL COURSE OF CANCER IN THE LIGHT OF CANCER RESEARCH[1]

By HARVEY R. GAYLORD, M.D., Buffalo, New York

IN attempting to deal with the clinical course of cancer in the light of cancer research, one immediately realizes how little the discoveries of the investigator in this field have come to influence the clinician. This is an unhappy circumstance, for in the last eighteen years our knowledge of the cancer problem has been greatly advanced. The time has come when some of the advances of cancer research should become the possession of the clinician and should be a part of his reasoning and guide him in the consideration of clinical cases. No doubt the clinician has properly felt that modern cancer research has as yet produced but little of practical value, and so far as revolutionary methods of treatment or diagnosis are concerned such a view, is at least in part, justifiable.

There are many ways in which the classical clinical picture of cancer should be modified by the discoveries in this field in the last two decades. Let us choose for consideration the immunity to cancer. Our knowledge of this subject has been gained by experimental studies with the smaller animals. Can we apply our knowledge of this phenomenon to the field of human cancer? To do this we must understand that our conception of the cancer problem and the group of diseases known as malignant has been greatly advanced in the last few years, and that much of the vagueness and uncertainty of the earlier period of research has been cleared away by a better understanding of the problem itself.

First of all the intensive study of types of cancer in the lower animals has shown us conclusively that cancer is not one disease but a great group of diseases. Of some of the neoplasms in the lower animals we have learned much. In one group, the chicken sarcoma, we have learned the cause, and in certain other groups, like the round-cell sarcoma in the dog, the spindle-cell sarcoma of the rabbit, the endemic sarcocarcinoma of the nasal passages in horses and cows, described by Stenstroem, carcinoma in the œsophagus and stomach of rats, by Fibiger, and that interesting disease known as carcinoma of the thyroid in the salmonoid fishes, our knowledge of the probable etiology is well advanced. With more exact knowledge the identity of each one of these diseases has become more pronounced, and so we know of a certainty that the different types of cancer which we have viewed collectively must now be studied individually. This has enormously broadened the cancer problem. It precludes the possibility of a sudden discovery which shall solve the whole problem readily, but it affords us the certainty that by studying its component parts and by the continuation of the progress which research has made in the past we shall ultimately come to understand that great group of diseases which we have recognized as cancer.

Investigators of cancer have worked with many types of neoplasms in the lower animals. We may choose the subject of immunity as affording a phenomenon which is common to all of them. We now know that, when the disease is transplanted, there is aroused in the organism of the affected individual a resistance. This resistance is greatest in the earlier stages of the disease. It is the force which holds the disease dormant or by its loss permits its progress, and in some instances it is the force which succeeds in overcoming the disease and producing those rare occurrences of spontaneous recovery, which have been observed experimentally and naturally in animals and occasionally in human beings.

In 1904 the workers in Buffalo had the good fortune to observe that mice inoculated with mouse cancer would sometimes develop tumors even of considerable size, that the tumors would then retrograde and disappear, leaving the animal immune to further inoculations. This fact has been repeatedly

[1]Read before the American Gynecological Society, Washington, May, 1916.

observed in various types of tumors in lower animals in all the laboratories of the world engaged in cancer research. It was also found that the chance of spontaneous recovery in inoculated animals was inversely proportional to the duration of the disease and the size of the growth, meaning that the chances of recovery are greatest in the very beginning of the disease. This observation is of great importance to the surgeon for the reason that he is constantly endeavoring to secure cancer cases early, and it explains why surgical interference in the very beginning of the disease is so much more successful than later. We were able to collect authentic cases from the literature which showed that in the earliest stages of the disease, even when all the growth was not removed by the surgeon, in some instances what was left retrograded and the immune forces were sufficient, on the removal of the greater portion of the growth, to overcome the rest.

In the first observations in 1904 we were able to demonstrate under the conditions, which then obtained in the mouse tumor which we were studying, evidences of a passive immunity. We found that the blood of mice which had recovered spontaneously had an inhibiting effect upon the growth of tumors if the animal was treated when the inoculated tumor was small. The blood of recovered animals had an inhibiting effect upon the rate of growth of more advanced tumors, so that there was a time when all the treated animals were alive and all the controls were dead. Furthermore, it was shown that in the early stages after inoculation the immunity aroused by the growth of the primary inoculation was sufficient to prevent, and for a considerable period, a successful secondary inoculation. This showed the existence of concomitant immunity. For the purpose of further demonstrating the existence of this concomitant immunity experiments were carried out to determine how it might be injured, and it was found that a mouse with an inoculated tumor which was growing but slowly or was nearly stationary could have its immunity exhausted by bleeding the animal. Loss of blood, either as a substantial hæmorrhage or the loss of two or three drops on successive days, would result in a sudden acceleration of the rate of growth of the tumor with a more rapid fatal termination than in the control animals. The existence of immune forces, which check the rate of growth of neoplasms, can be traced in spontaneous tumors in animals, and on consideration the clinician will readily see that this offers an illuminating explanation of the variations in rate of growth and long periods of latency in clinical cancer in human beings.

Having determined that loss of blood injured the resistance, it naturally occurred to us to determine the effect of anæsthetics upon the rate of growth, and we found that inoculated tumors in animals which were chloroformed for a considerable period, or for short periods on succeeding days, developed a much greater rapidity of growth, than control animals. In this connection, chloroform was found to be more injurious than ether.

Three years ago Dr. Tyzzer, working with carcinoma of the breast in the Japanese waltzing mouse, carried out an elaborate series of carefully controlled experiments which showed that operations upon inoculated tumors accelerated the rate of growth of metastases or of secondary implants. In these experiments he used ether anæsthesia, and they were of course associated with the usual loss of blood attendant upon such operations.

These observations are surely of importance to the surgeon. What surgeon has not occasionally encountered a favorable-looking cancer case in which the growth has progressed but slowly, which, after a radical operation with anæsthesia, suddenly recurs and grows at a greatly accelerated rate terminating rapidly in death. Every surgeon has had the experience of seeing cases which he wished he had not operated upon, in that the operation did not prevent recurrence and after prompt recurrence the progress of the disease was greatly accelerated. Experiments are now being conducted to determine whether nitrous oxide anæsthesia is less injurious than chloroform or ether. In the same article Dr. Tyzzer showed that in the Japanese waltzing mouse tumor, which animal possesses a complete susceptibility to the

tumor, and in which immune phenomena are nearly absent, by massaging the tumor he was able to produce metastases almost at will, even in the earliest stages of the disease. In two other propagable tumors, one a cancer of the breast in a mouse, the other a sarcoma in a mouse, such massage during the early stage did not produce metastases. That in many primary human tumors the immunity is sufficient to prevent the metastases may be deduced from the observation of Goldmann, who showed in 1897 by a careful study of cancer of the breast in human beings that cancer-cells enter the circulation in many such instances without the production of metastases.

The nature of the immunity to cancer has for ten years been the subject of active discussion. The so-called "atreptic" theory for cancer immunity advanced by Ehrlich has been generally disproved by investigators. Our original observation that there were probably immune forces in the blood serum of recovered animals did not meet with prompt or wide acceptance, because of the constantly changing conditions which surround such experiments when carried out on living animals.

With the round-cell sarcoma of the dog Crile and Beebe were very shortly able to demonstrate the existence of immune bodies in the blood of recovered dogs by transfusing such blood into animals with tumors, observing prompt regression and recovery in repeated instances. Lewin, in Berlin, succeeded in demonstrating the existence of immune forces in the blood of recovered rats in a spindle-cell sarcoma of the rat; and von Dungern found marked evidence of passive immunity in the spindle-cell sarcoma of the German hare. Other investigators, working with different tumors and probably under unfavorable conditions of experimentation have failed to repeat the earlier experiments with the mouse tumors. Clowes, in the Buffalo laboratory in 1904, mixed the blood of recovered animals with a given, measured amount of mouse cancer before inoculation and was able to show that under these conditions the number of successful inoculations was markedly reduced. Bashford found that mouse cancer-cells inoculated into the circulation of spontaneously recovered mice failed to produce tumors and disappeared, and Tyzzer has recently shown that, by treating the graft of a Japanese waltzing mouse tumor with the blood of recovered white mice, he was able to produce in the immediate neighborhood of these grafts the marked cellular reaction which is found in resistant animals. Weil, who some years ago carried out a series of experiments with the Buffalo spindle-cell sarcoma of the rat and was unable to convince himself of the existence of immune bodies in the blood, has just reported at the meeting of the American Association for Cancer Research on May 8, 1916, that by modifying the experimental conditions he has now been able to demonstrate to his satisfaction the existence of definite immune forces in the blood of spontaneously recovered rats.

It is not necessary for us to attempt to consider the exact nature of this immunity, but we might point out that the immunity is probably specific for each type of cancer, and that in the chicken sarcomata of Rous, where this investigator has been able in three different types of sarcoma to filter out a virus, he has been able to test the question which has long been before investigators whether the immunity to cancer is directed toward the cause of cancer or is a cytolytic action against the cells, and Rous has been able to show that a chicken which is immunized against the spindle-cell sarcoma is not immune to the virus of the osteochondrosarcoma, although both of these tumors are of connective-tissue origin.

It may well be asked to what extent we may apply these facts so laboriously wrung from experiments upon animals, to cancer as it exists in human beings. Some of these data must immediately awaken sympathetic response in the mind of the physician, and it is not for me to point out the application, but it would greatly interest any clinician to read again a very suggestive article by Petersen in the *Beitraege zur klinischen Chirurgie*,[1] in which he postulated the existence of immune forces in human cancer cases. Petersen's theories were deduced from a careful

[1] 1902, xxxii and xxxiv.

and exact study of cancer in human beings, and preceded by two years the first conclusive proofs of immunity to cancer in animals. He thought of the possible antibodies as being of a cytolytic nature, but such a conception was at that time very natural.

Marked advances have been made in the last few years in our understanding of the nature of this immunity to cancer. It was shown early in experimental work with animals that among normal tissues the spleen was particularly efficacious in immunizing animals against inoculation with propagable cancer. Bridré and Apolant immunized animals with normal spleen tissue, and Braunstein showed that by removing the spleens of resistant animals they became susceptible; but the definite demonstration that the immunity to cancer has its origin in the splenolymphatic system, which is the seat of all known immunities to infectious diseases or non-specific substances, was not conclusively demonstrated until Murphy, by an ingenious series of experiments, showed that in chick embryos the growth of normal chicken spleen would prevent the growth of neoplasms inoculated into the embryo, which, in the absence of an accompanying growth of spleen tissue, would grow readily. He also showed that neoplasms which could be successfully ingrafted in the chick embryo could be made to retrograde by the subsequent implantation and growth of normal chicken spleen, and following these facts he found that by injuring the spleen in resistant mice they could be made susceptible to the growth of mouse cancer or even of alien tumors so long as the injury to the spleen remained, and that with the regeneration of the splenolymphatic system the immune forces were re-established. Hence it is now definitely understood, first through the early experiments in Buffalo, with subsequent confirmation, that the immunity to cancer is evidenced by the existence of immune forces in the blood. Second, the site of this immunity is in the splenolymphatic system, where all the known types of immunity take origin.

Reasoning from the experimental demonstration of these forces in inoculated animals to the existence of such forces in animals spontaneously suffering from cancer and to the phenomena observed in the clinical course of cancer in human beings, we have before us the logical explanation of many vagaries and ill-defined phenomena in cancer in man. We understand now why surgical interference is so successful in the very first stages of cancer, and why it is so unsatisfactory in the later stages. We should be cautioned against tedious and long-drawn-out operations using chloroform or ether as an anæsthetic, and associated with marked loss of blood; and we can offer certain evidences to show that X-ray and radium exercise their curative effects through the immunity.

In 1905 in Buffalo we observed that tumors, which were held stationary by X-ray treatments, could be made to grow by bleeding the animal exactly as in the case of tumors stationary in the natural course of the disease. From this we reasoned that X-ray and radium operated through the immunity. Recently Murphy has conclusively confirmed this view by showing that spontaneous mouse tumors, if removed and given the X-ray treatment, can be reinoculated into the animal with almost the same percentage of success as where no treatment is given. (In spontaneous tumors the primary tumor can be removed and portions of it can be reimplanted in practically 100 per cent of cases.) Then Murphy showed that, if the tumor was removed and the X-ray treatment was given to the mouse, the reimplantation of a fragment of the tumor almost invariably failed, showing that the animal had been made resistant by the X-ray treatment. From this he properly reasons that the therapeutic effect of the X-ray or radium is in large part secondary and not alone the result of the direct action of these agents upon the tumors.

An understanding of these facts enables us to explain why in many instances a few treatments with the X-ray or radium produce marked benefit and then suddenly without any apparent cause such treatments lose their effect and the tumor grows rapidly in the face of the treatment. Knowledge of the existence of immunity to cancer affords us the basis of research to determine the exact modus operandi of X-ray and radium and

will undoubtedly enable us to secure with certainty the beneficial results of these agents in those cases in which the existence of a sufficient immunity permits successful treatment.

These are some of the ways in which cancer research should assist the clinician to a better understanding of the clinical course of cancer. The outlook of cancer research and the prospects of practical help for the clinician are many times brighter today than they were eighteen years ago when experimental cancer research may be said to have been founded.

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THE CONSTITUTIONAL FACTOR IN GYNECOLOGY AND OBSTETRICS[1]

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IN this contribution on the constitutional factor in gynecology and obstetrics, certain principles will be presented which are demonstrated by biologic, human clinical pathological, human antenatal pathological, comparative pathological, or by experimental teratological, evidence, or by a combination of such evidence.

A recognition of these principles will greatly enlarge the powers of the practitioner of medicine: (1) By enabling him to obtain a comprehensive understanding of the biologic relations of medicine; (2) by increasing his powers of diagnosis; (3) by increasing his powers of prognosis; (4) by enabling him to avoid many current errors in therapy, both operative and general; (5) by increasing his powers therapeutically, through enabling him to substitute general nutritional, and developmental therapy, when indicated, for local therapy currently employed, and, thus, to effect the cure, instead of the amelioration, of his patient's condition; (6) by enabling him to give scientifically based advice as to methods of living, both positively and negatively, when the biologic type of the patient is recognized; to promote the development of environmentally arrested patients; and to enable them to maintain their health, by living within their particular potential or capacity to produce energy, instead of attempting to live as is physiological for typical individuals, but which will cause disease in the arrested, or hereditary and environmental devolutes.

Since Marion Sims made practicable an operation for the cure of vesicovaginal fistulæ, gynecology has, more and more, developed as a surgical specialty; and while gynecologists have elucidated the morbid anatomy of their specialty, their attention has been chiefly fixed upon the perfecting both of the details of aseptic surgery and of the technique of the various particular operations which have been originated for either the relief or the cure of the diseases and of the morphological anomalies of women. During the same period, development in obstetrics has also been largely surgical in its character. So much is this true that gynecology and obstetrics have both tended to become surgical specialties; and the drift in practice, in the United States, has been toward the abolition of the specialty of gynecology, and the taking over of the duties of the gynecologist by the general surgeon. The writer has never been in sympathy with this tendency in America, but has, on the other hand, felt that the

[1] Read before the American Gynecological Society, Washington, May 1916.

German practice of combining gynecology and obstetrics has much to recommend it, especially from the standpoint of teaching and of theory. He is willing to grant that the practical difficulties which exist in the United States render such a combination of duties relatively impracticable from the financial standpoint, with us; but is not willing to admit that the general surgeon, who has not served an apprenticeship in an obstetrical hospital and who has not been trained as a neurologist — and especially, who has not been trained as a psychic analyst and diagnostician — is capable of making discriminating diagnoses in the department of gynecology, and, as a consequence, is not capable of properly discriminating between conditions requiring an operation for their cure and those which are merely incidental to constitutional manifestations, or to morbid symptoms referable to the nervous, glandular, or the hæmatopoietic systems.

The unfortunate result of this lack of discriminating insight on the part of general surgeons is the performance of a great many unnecessary, and therefore harmful, operations by them and by general practitioners doing surgery. This lack of training and of insight into the nature of the diseases of women which it occasions, is the cause of a smaller number of sins of omission.

The sins of commission have been, for the most part, in the field of the ptoses and of the various forms of arrest of development of the uterus. Because of the hysterical craze to perform nephropexy which followed the appearance of the early papers of Edebohls and of the writer, in the nineties, when a large proportion of general surgeons, operating from "a morphological basis," stitched up all kidneys they could feel, there followed a reaction; whereupon all those calling themselves conservative stitched none. This operative craze was almost as widespread as that of "dilatation and curetting" for arrest of development of the uterus — and as baseless. It is true that patients with a hypoplastic constitution and also those having "long waists," almost invariably have low placed and quite movable kidneys; this status of the kidney in such constitutions is quite normal, and therefore produces no morbid symptoms. Nevertheless, in the minority of instances, perhaps 10 per cent, when such individuals make overdrafts upon their nerve force by doing more than their capacity for work permits, nervous exhaustion, loss of fat, and a more atonic state of the fibrous and other tissues ensues, with increased movability of the kidneys, and, in certain cases, torsion of the kidneys, and consequently a relative, intermittent obstruction of either or both the renal veins and ureter follows, with congestion of the kidney, and at times grosser lesions, as a consequence. In such cases nephropexy is indicated, not to cure the general nervous symptoms due to nervous exhaustion in hypoplastic individuals, but to relieve the local morbid condition, due to local causes and conditions. The same state of facts obtains with reference to the other ptoses, both abdominal and pelvic, and this is also true of other conditions which are, like the ptoses, usually due to environmental hypoplasia or arrested development due to faulty environment.

Sins of commission and of omission are not peculiar to either the general surgeon or to the general practitioner. Those of us who have been in the profession long enough to remember the status of practice in the eighties and nineties will recall that those gynecologists who are euphemistically classed either as enthusiasts or as radicals have an equal or a greater number of sins of commission to their discredit. This form of enthusiasm and of radicalism is due either to lack of discriminating judgment or else to a poor development of the ethical inhibitory apparatus.

Prior to 1900, the minds of gynecologists were largely taken up with the development of the details, first of antiseptic, and second of aseptic surgery, until the principles and practice of aseptic surgery were thoroughly worked out, including the installation of suitable apparatus for the preliminary sterilization of instruments, dressings, and the other paraphernalia of operations. The character of the operative technique of that period is best described as meticulous, and the mental concentration involved in performing many operations used up about all of the mental

capacity of the gynecologist, so that he had little intellectual energy for the study of pathological problems, and none, or almost none, for the study of the biologic basis not only of gynecology and obstetrics but also of medicine in general. In his student days he heard the professor of anatomy make some reference to comparative anatomy, as explaining some of the more recondite problems of human morphology; also, either in the anatomical or in the obstetrical lectures a superficial knowledge of the more elementary facts of embryology were learned; and certain of these facts were employed in the explanation of anomalies met with in surgical practice. The younger men in the profession have had a course in elementary botany and zoology, and have received some training in biological philosophy; which knowledge was seldom a part of the medical training of their elders, in America.

Also, it is a regrettable fact that the Virchow school of pathologists has turned its attention, almost entirely, to the observation and description of detailed phenomena or facts; and, like the founder of the school, has decried attempts to interpret the mass of facts observed, by hypotheses, as had been the custom in the medical profession and in the broader school of natural philosophers throughout past ages, and this is a perversion of the teaching of Bacon as to the application of the experimental method of arriving at truth. Virchow and his followers condemned what they call theorizing, and, at least relatively, those whom they call theorizers — utterly oblivious of the truth enunciated by Confucius that "undigested facts lead to confusion."

Fortunately, all pathologists and physiological chemists were not obsessed by the fallacious portion of the teaching of Virchow and also of his followers; otherwise, little or no progress would have been made in medicine as to the theoretical interpretation of morbid phenomena since Virchow's orbit appeared above the medical horizon. Such men as Pasteur, Lister, Koch, Metchnikoff, and Ehrlich have followed the methods of the Fathers; to digest facts and to extract the truth from them, or to reduce observed phenomena to principles, through their correlation and interpretation.

The unfortunate consequence of this teaching and practice of the Virchow school was the amassing of such an enormous mass of unexplained and largely useless data that no human mind could remember them, and should one accomplish the Herculean task he would inevitably have suffered with mental indigestion from having crammed his memory with such a mass of uninterpreted facts. This state of affairs was well set forth by Adami in the preface to the first edition of his masterly treatise upon human pathology.

The further and even worse consequence of the obsession of the profession, with reference to the importance of this teaching of Virchow, was that the lessons of the ages from the days of Hypocrates down were largely forgotten. The minds of so-called scientific clinicians were so exclusively taken up with speculations upon the nature of the minute morphology of the morbid processes constituting disease and as to how these would appear if seen under the microscope, that they have largely passed by the fact that these reactionary processes are only a small part of the problem set before them for their solution. The doctor's problem has to do with the human being who is sick, primarily, and it has, only secondarily, to do with the patient's sickness.

Disease is the reaction of an organism to an environment sufficiently unfavorable to produce either local or general discomfort, or other disordered functions, or death. The morbid process is the reaction to safety of the organism in general, or *in loco*, against the unfavorable environment in its effort to get rid of the influence of the pathogenic agency; which analysis shows in some protoplasmic poison introduced into the organism, or which fails of proper elimination when generated within. The type of reaction, in degree, if not in kind, is due to the type of the organism or the constitution. This factor in medicine, which constitutes the major portion of the doctor's problem, when confronted as a practitioner with disease, has been almost wholly lost sight of and has not been taught to medical

students since the profession became obsessed with the teachings of Virchow; and this has resulted in the spread of therapeutic nihilism. It is only in the immediate present that medical works are appearing which indicate the beginning of a reaction from the fallacious portion of the teaching of Virchow and a return to the point of view of the Fathers in Medicine. In its modern form this reaction is called the biologic or genetic concept of medicine.

Intelligent and careful observation of the character of febrile reactions in the human family in the past had enabled the Fathers to differentiate between three types of fever: (1) The sthenic type; (2) the asthenic type; (3) the nervous or irritable type. It was upon a recognition of the type of the fever that special therapy was based. These *three types of febrile reaction* correspond with the *three great groups of human beings, from the biologic standpoint:*

1. Those coming of sound stocks and having a good constitution, or typical individuals or evolutes.

2. Those coming of stocks constitutionally defective in one or more of their organs or systems of organs, which states were formerly described as diatheses or dyscrasias or hereditary devolutes.

3. Those whose ontogenesis has been arrested by unfavorable environment in the preconceptional, germinal, embryonal, fœtal, or post-natal — infantile, puerile, adolescent, or the youthful periods of ontogenesis. The arrest manifests itself either as an absent part, or as a morphological malformation in those in whom the protoplasmic poisoning of the developing organism due to disease in the mother occurs during the early weeks of pregnancy, when organs and systems of organs are being laid down; whereas, when this poisoning occurs later in pregnancy, after the systems of organs have been developed and also when it occurs in post-natal life, its consequences are manifest in a general instead of a particular arrest of growth, and in a lessening of the potentiality of the organism to develop full energy. This latter state may likewise be due to poisoning of the ova and of the spermatoblasts and spermatozoa prior to conception, during the dual life of a human being in the environment of the ovary and of the testis, respectively. Those belonging to this group are environmental, hypoplastic devolutes.

4. A mixed, subgroup, having both hereditary and environmental defects — both hereditary and environmental devolutes.

The *sthenic type of fever* is the reaction typical of those having sound constitutions, when suffering from a marked local or general infection. The *nervous or irritable type* of fever is that characteristic of hereditary devolutes, and more especially of those having an inherited nervous diathesis. The *asthenic type of fever* is that characteristic of environmental, hypoplastic devolutes, under similar conditions. The *mixed or nondescript forms of fever* characterize the reactions of those belonging to the fourth, mixed, or subgroup of both hereditary and environmental devolutes.

The writer had the good fortune to begin the study of medicine prior to the obsession of the profession by the fallacious portion of the teachings of Virchow, when the wisdom of the Fathers of Medicine was still taught to medical students. It was of great interest to him to realize the insight of the older clinicians in their classification of "temperaments," and of constitutional reactions to infection, when, after working upon the subject from 1886 until 1908, he realized the nature of environmental constitutional hypoplasia, and the relations of bad environment in ontogenesis, and of heredity, to the production of the two great types of devolving human beings, as set forth in his papers, entitled "Hereditary Hypoplasia in Man, Due to Degeneracy,"[1] and "The Law of Degeneracy in its Relation to Medicine."[2]

When these papers appeared they attracted but little discussion and most of that was unfavorable. This fact was, at first, difficult of comprehension; but upon reflection its explanation was seen to be in part that more especially the paper on "Hypoplasia" was poorly written, and in part that doctors in general know little of biology, and care less.

[1] Tr. South Surg. & Gynec. Ass., 1908, December 16; J. Am. M. Ass. 1909, lii, 552; Tr. South Surg. & Gynec. Ass., 1909, xxi, 462.

[2] N. Y. M. J., 1910, xcii, 1261; Tr. Coll. Phys., Phila., 1910.

They have been satisfied to follow blindly the lead of Virchow, who, according to Haeckel, became blind himself quite early in his career and became a reactionary. Those who had received a biologic training had been trained in the school of Weismann, whereas these papers were written in accordance with the views of evolution of Lamarck, Darwin, Haeckel, and the paleontologists. Hence, among those having had zoological training, they encountered prejudices arising out of the controversies between the neo-Darwinians and the Weismannian group of zoologists. Thus the work, when presented, was stillborn.

It became evident that it would be necessary to study the biologic relations of the human problem which had been worked out, in the light of the teachings of Weismann, and of Mendel; which study occupied nearly four years, when it became feasible to restate the nature of environmental, congenital, hypoplasia discriminatingly, and to point out how that although congenital, it is not hereditary, but is due to poisoning of the ova (or the spermatoblasts), prior to conception, or to poisoning of the impregnated ovum, during various stages of embryonic development; and also that constitutional hypoplasia or arrest of development can arise at any time during post-natal life, from bad environment. In this way a sharp distinction can be drawn between defective constitutions of *strictly hereditary origin*, and those having a *strictly environmental causation*. But the latter may become hereditary in the future generations, or the descendants from such parentage, i.e., an individual having arisen from an ovum poisoned in the ovary of the mother, or from a spermatozoon poisoned in the testis of the father, will not be able to produce typical offspring. It was also shown that a large mixed, or subgroup exists, exhibiting both morphological and functional defects — some of hereditary and some of environmental origin. It was at the point of "Affection of the Ovum" (Weismann), that the two great groups of devolutes were brought in due relation the one to the other; and, thus, the difficulty arising from the assertion of the Weismann school as to the impossibility of "inheriting acquired characters" was avoided.

It was learned during this time, through the study of antenatal pathology in the human and the study of experimental teratology that both clinical pathological and experimental laboratory evidence is available to demonstrate the correctness of the concept of environmental constitutional hypoplasia or environmental degeneracy in accordance with the strictest requirements of the Virchow school. As Professors Mall and Stockard put it: "All terata, not dying *in utero*, are born alive, and those that live to mature years continue to be terata." These manifest every degree of defect from a mere incapacity to develop full constitutional energy — *asthenia universalis congenita* or constitutional inferiority or the broader concept of infantilism — as one extreme, to gross monsters as the other extreme; with special deformities, such as one-eyed terata, spina bifida, cleft-palate, harelip, club-foot, infantile vagina, uterus, etc.; and also the greater degrees of asthenia, and varying special defects of organs, and systems of organs, as diathetic types of environmental defects, between the two extremes already mentioned.

Experimental teratology has now reached the degree of development in its principles and methods that it is possible to produce 90 per cent of certain forms of terata to order, by means of the poisoning of fish eggs upon different days in their development, by special poisons applied in prescribed strength.

The application of these principles to gynecology and obstetrics in explaining the nature of the relation of the particular type of constitution of a patient to disease is apparent.

The diseases and morbid states which constitute gynecology fall into a few groups:

1. Infections (a) of the mucous surfaces of the genito-urinary tract; (b) of the peritoneum; and of the tissues, cellular, glandular, and muscular, contiguous to both.
2. Malpositions, and more especially ptoses of the pelvic and abdominal viscera.
3. Tumors (a) benign and (b) malignant.
4. Lacerations.
5. Hypoplastic states of organs, or systems of organs, arrested in their development; a few from hereditary causes; and most of them from environmental causes.

6. Functional psychic and somatic disorders due to maladjustments of sexual life.

The above grouping constitutes the whole of gynecology in principle.

Most of the above morbid states are atypical, morphological phenomena; *they are not morbid entities or diseases, but are merely phenomena or episodes in the ontogeny of a constitutionally hypoplastic individual,* whose development has been, relatively, arrested. The morphological facts in connection therewith include a persistence of fœtal, infantile, and puerile positions and conformations of the organs concerned: such as an infantile or adolescent uterus, ovaries and fallopian tubes, the pelvic and the low placed kidney, infantile, puerile, and adolescent forms and positions of the gut; and also puerile or childish, or adolescent, morphological forms of the entire trunk, including, more especially, the chest and abdomen, which characterize the hypoplastic constitution. Also defective, because arrested, nervous, and vascular supply to the various viscera, and also, a defective cerebral and spinal nervous development, and likewise capacity for function.

A careful and discriminating analysis of the types of disease and of morbid states which constitute the department of medicine called gynecology will show either that the constitutional element is the dominant factor in these conditions or else that it enters very largely into them.

It is true that when environment is sufficiently unfavorable, evolutes or typical human beings, or those coming of sound stocks and having good constitutions, will become diseased. The subject of immunity, its essential nature, and the principles and the processes which apply to and govern its manifestations are, in detail, as yet imperfectly understood. The view of the Fathers of Medicine that "vital resistance" is possessed in greater or lesser degree by different individuals remains true. It is also true that the same individual resists a certain form of infection at one time, and becomes infected by the germ at another time.

Essentially, the additions to the knowledge of the Fathers which have been made by modern investigators are the teachings of Metchnikoff concerning the phagocytic function of the white blood cells or leucocytes, and the teachings of Ehrlich and Wright concerning the formation of immune bodies in the blood plasma or antibodies, which by chemical union with certain of the molecules of the invading germs devitalize them, so that the white blood-cells can destroy them by phagocytosis; or they form antibodies in the plasma or lymph, which will agglutinate or dissolve the invading germ or foreign body, and thus rid the invaded organism of it.

When Virchow and his school brought forward the cellular theory of disease, humoral pathology was called antiquated and unscientific. Modern serology and immunology have brought the profession back to the viewpoint of the Fathers, as to the important functions of the blood-plasma and lymph in the self-limitation of disease, or, otherwise, as to the nature of the defensive or conservative reaction of the organism in ridding itself of poisons, which reactions constitute pathology.

Humanity exists in three series or groups, with a mixed series or subgroup, and as each human being has his own health level or state of vital resistance, it follows that the percentage degree of the incidence of infection depends largely upon the constitutional factor in an individual subjected to the influence of a pathogenic germ, and the possibility of infection, and in part upon the virulence or vitality of the pathogenic germ. This percentage degree, as has been seen, fluctuates in particular individuals from time to time. In general, the vital resistance of evolutes is greater than that of hereditary devolutes, and this is greater than that of environmental devolutes, and even more that of the mixed group devolved from both sets of causes. These are the constitutional factors entering into the nature of infection and immunity in gynecology; and, likewise, all prognoses as to recovery, in particular individuals.

The constitutional factor entering into the problem of malpositions of organs and groups of organs, both pelvic and abdominal, is twofold. All of the malpositions due to arrest of development and to the persistence of the

anatomical forms and relations of periods junior to that of the adult are, clearly, constitutional in their nature. In the past, such malpositions have usually been classed as congenital, although this is in large part erroneous.

Truly acquired malpositions of organs are due either to constitutional weakness — nervous exhaustion, constitutional weakness due to disease, malnutrition, acquired atonicity of the ligamentous supports and of the cellular tissues about organs, and to the absorption of fat from the cellular tissues; or else they are due to injuries producing direct lack of support, such as lacerations of the pelvic floor, or to diseases, or accidents, bringing about continued congestion with increase of weight of the organ involved, or they are due to increased pressure from adjacent organs or viscera, or to maladjustments of "lines of internal pressure," due to alterations in the configuration of the trunk, producing these maladjustments within the abdomen and pelvis.

Except some of the accidents causing traumatism, and lacerations, *all of these conditions have a constitutional origin;* which involves the conclusion that *their scientific treatment must be constitutional in character;* the removal of the cause, regulated rest and exercise, and the improvement of nutrition, through the employment of regulated diet (even though local measures may also be advisable, helpful, or essential) in order to effect a cure, and to maintain the subsequent health of the patient.

The essential nature of tumors, their ultimate and their proximate or exciting causes, there is every reason to believe, is a combination of the presence of relatively embryonal cells, or cell-rests in the tissues of organs, or in the tissues in general, which under the usual conditions of health remain quiescent; but which under excitation of either a physical or a chemical nature take on growth, and, being relatively embryonal or not somatized, tend to produce tissues, or structures, imperfectly resembling the tissues which they would have formed had their somatization not been prevented during embryonal, or fœtal, life. As the exciting physical, or chemical, cause differs in kind from vital or growth force, and as the cell, or cells, are themselves atypical from arrest, it is natural that the tissue formed by the multiplication of the arrested cell, or cells, should be aberrant or merely resemble, and not be identical with the particular type of tissue or structure.

The writer has long been convinced that carcinoma and sarcoma are merely manifestations of marked degrees of arrest or degeneracy, either general or particular, or both, The whole weight of evidence, clinical and pathological, in the human and in animals, together with the failure of the investigators in this department to find an adequate explanation or cause along the lines they have followed, strongly supports this view. The existence of "cancer areas" or "cancer belts," commonly in "shut-in" or isolated communities, whose original settlers were largely of unsound stocks, and the steady increase in the incidence of cancer, *pari passu* with the increase in the percentage of both hereditary and, more especially, environmental degeneration, in relation to the maleficent influence of urbanization (with its type of living, especially for the poor, so little in accord with the habits and conditions under which evolving man has lived in the past), is strongly corroborative of this view. It is further supported by such observations as are available concerning the incidence of cancer, including sarcoma in wild animals when their environment has been so altered as to be inimicable to their welfare. The facts as to the percentage incidence of malignant tumors in domesticated animals, and in wild animals kept in menageries and zoological garden in comparison with wild animals living in their natural habitat, is equally corroborative. The reports of pathologists attached to zoological gardens, and the facts of comparative morbid anatomy as they are set forth in such works, are available to students of the subject. The high ratio of sarcoma among hares which are "preserved" in Europe, when permitted to increase beyond a certain number to the acre, and the disappearance of sarcoma when the number is kept within due limits (and also the facts as to laboratory rat and mouse cancer) lend support to the

same view. On the contrary, it is maintained that cancer is very rarely found in wild animals living in their natural habitat. The same contrasting set of facts is true of aborigines when living a barbaric or savage life, and after becoming degenerate from encountering the evils of civilized conditions. For example, cancer was practically unknown among the Negroes shortly after being brought from Africa, whereas, today it is as common among them as it is among Caucasians.

Much more evidence of a similar kind is available, all of which, while not demonstrating, from the standpoint of the laboratory, the origin of cancer in degeneracy or arrest of development of an individual cell, or cells, when embryonal, and their subsequent stimulation, or irritation, into atypical growth in the adult, by either physical, or chemical, agencies, makes such a hypothesis much more than probable.

In discussing this question with Professor Stockard, he stated that the facts of experimental teratology not only lend support to the above hypothesis concerning the origin of cancer, but also equally explain the origin of benign tumors. The question as to whether arrested embryonal cells, when irritated into growth and cell division, form a malignant or a benign tumor, depending upon the degree of their somatization when arrested (or the absence of any somatization), together with the nature of the protoplasmic poison which irritates or stimulates them into growth and multiplication of cells, and also the intensity of the poison, due to the quantitative dose of the particular poison, whether chemical — as circulating toxines, or physical — as the X-ray, radium, heat — as in certain lip-cancers from smoking, or from traumatism — more especially when a long-continued irritation is kept up. This view of the origin of tumors is a combination of the theory of Cohnheim, and the clinical evidence, human and from comparative medicine, together with the facts of experimental teratology.

The application of the foregoing principles to obstetrics is that they constitute the genetic explanation of certain obstetrical problems: (1) Sterility, relative and absolute; (2) toxic states, arising during pregnancy; (3) atonicity of the uterine muscle, and lack of power on the part of the woman in labor to deliver herself; partly from arrest of development of the uterus and partly from imperfect innervation, due to arrest of development of the nervous system, with imperfect capacity for functioning; (4) lacerations in childbirth; (5) abortions.

1. Absolute sterility in women is due to the absence of the ovaries, fallopian tubes, uterus or a combination of these; or it may be due to the absence of, or the obstruction of, the vagina, or to the imperforate condition of the hymen. Relative sterility is due to imperfections from arrest of development of one or more of the structures essential to impregnation; or it may be due, in a few cases, to sexual incompatability between the mates, the nature of which is not understood, although the fact is unquestionable; and, finally, it may be due to obstructions, or altered secretions, due to infection.

In this sophisticated day relative sterility is largely volitional, and volition arises either from ignorance of the whole truth or more often from selfishness.

2. Toxic states are due either to ingestion of an undue amount of alimentary substances with consequent faulty digestion and defective anabolism or, and more often, to defective glandular organs of digestion, assimilation, and excretion, together with defective ductless glands, whose harmones activate and largely regulate the chemical processes of metabolism. It is natural that toxic states should arise more frequently in pregnant women than in the non-pregnant, because the pregnant woman must perform most of the processes of metabolism for two beings, instead of for one — herself. As a consequence, those suffering from hereditary diatheses involving the organs of digestion and excretion — anabolism and catabolism — or those suffering from arrest of development from faulty environment or environmental hypoplasia, are more subject to the incidence of toxic states than is true of evolutes or typical women. The morbid states, more particularly referred to, are clinically classified as vomiting in pregnancy and eclampsia.

3. Hereditary devolutes having a nervous diathesis, have a well developed uterine musculature, and as a consequence have sufficient driving power to deliver themselves in labor. However, their nervous systems are atypical — hypersensitive, and, relatively, explosive in functioning. As a consequence, such women suffer inordinately in labor and tend to become exhausted from misdirected application of their energies and from the morbidity of the excess of their sufferings from the pangs of labor. They require the assistance of the obstetrician to effect delivery more frequently than is true of typical women.

4. Environmental hypoplastic devolutes are relatively sterile from the relative infantile, or adolescent, type of their sexual organs. The musculature of the uterus, relatively, is imperfectly developed, and the innervation of the uterus is likewise imperfect. Also their general reserve store of potential nervous energy is small. As a consequence, labor in this group of women tends to be powerless. The puerpera tends to become exhausted, and more frequently requires the assistance of an obstetrician to terminate labor than is true of any other class of women. Likewise, as the anatomical parts involved in parturition are imperfectly developed, they tend to function poorly, whether it be the generating of energy by the upper portion of the uterus, or the passive relaxation to promote dilatation of the cervix uteri, and of the vagina, and of the muscles of the pelvic floor. Innervation and the correlation of nervous functions are imperfect.

5. Lacerations in childbirth are due either to imperfection in development of the structures involved, or to disproportion between the passage and the passenger, which disproportion may be essential or may be due to failure in the mechanism of labor itself. It is natural that a poorly developed cervix uteri should fail to relax and be stretched sufficiently to permit the egress of the fœtus without laceration in the same percentage of cases that is true of typical women. This same state of facts applies to the dilatation of the small imperfectly formed vagina and pelvic floor of the environmental hypoplastic devolute, as compared with typical women.

6. Abortions are due either to disease of the endometrium, to toxic states of the mother or of the father, or to criminal interference with pregnancy. The constitutional factor in each of these sets of causes of abortion is so apparent as not to require amplification.

The neuroses and psychoses of genital origin are both obstetrical and gynecological in their nature. The neurologist and the psychiatrist will each claim these functional nervous troubles as belonging to his particular specialty, but such neuroses and psychoses as arise from the maladjustments of sexual life, properly belong in the gynecological and obstetrical departments of medicine.

It is only by the study of woman as a functioning animal in the sexual sense, and by discriminating observations and analysis of the functioning of her sympathetic and cerebrospinal nervous systems in relation to the sexual life, from adolescence onward, in its relations to the somatic, the mental, and to the spiritual or emotional life, and to the expression of each in function, that an adequate understanding of the nature of woman and also of her nervous disorders, both somatic and psychic, can be attained. This is one of the chief grounds for the existence of the specialty of gynecology and obstetrics; and it is in the study of the psychic functions of woman and their influence, and more especially of the influence of emotional states upon the health of women and in the causation of functional sexual disturbances, that the general surgeon and the average family doctor fail in comprehension and insight, as to whether particular symptoms have a local morphological basis, or, on the other hand, are caused by morbid emotional states, acting through the sympathetic nervous system and through the ductless glands. It is in just this large group of morbid condition that their lack of discrimination in diagnosis is most manifest, and results in the numerous sins of commission, and, the lesser number of omission, which they inflict upon their women patients.

CONCLUSIONS

1. The theory of environmental, constitutional hypoplasia or arrested development from unfavorable environment, operating at

any period from the preconceptional state of dual life in the ovary and testis to that of the youthful period in ontogeny, which was presented to the profession as a medical hypothesis in 1908, and which the writer believed to be proved upon human clinical and pathological evidence, is now shown to be equally supported by the clinical and the pathological facts of antenatal pathology and by the facts of comparative pathology, and to be demonstrated by facts of experimental teratology.

2. The wisdom of the Fathers of Medicine, as expressed in their discriminating analysis of the facts of the hereditary nature of the diatheses or dyscrasias, together with the theory of environmental hypoplasia, constitute the law of devolution in its relations to medicine.

3. In order to obtain a comprehensive understanding of the practice of medicine, it is necessary to reject such of the teachings of Virchow and of his followers as are fallacious and to combine the clinical wisdom of the Fathers of Medicine, from Hypocrates down, with the known facts of experimental medicine and their correct interpretation, and thus to arrive at the true point of view from which to study and to deal with the clinical problems which are the concern of practitioners of medicine and of each of its specialties.

4. The constitutional factor in gynecology and obstetrics, as is equally true of the other departments of medicine, is the chief element in the clinical problems which confront the practitioner in dealing with disease and with atypical organs and tissues and their functions; because it is the factor which determines the nature of the reaction of the organism to a pathogenic environment or disease, or it constitutes the sole factor in the atypical morphology and function, in the patient.

5. The recognition, comprehension, and employment of the foregoing principles will greatly enlarge the powers of the practitioner of medicine in diagnosis, prognosis, and in therapy; in which it will enable him to avoid many common if not habitual errors, and, positively, to substitute general nutritional and developmental measures for the local measures currently employed, and thus to effect the cure, instead of the amelioration, of his patients' condition, when due to environmental arrest. Further, it will enable him to give scientifically based advice as to methods of living, when the biologic type of the patient is recognized; to promote the development of enviromentally arrested patients; and to enable them to maintain their health by living within their particular potential or capacity to produce energy, instead of attempting to live as is physiological for typical individuals, but which will cause disease in the arrested — or hereditary and environmental devolutes.

6. There remain, unsolved, two problems: (1) The process of mechanism whereby atypical morphology and function of environmental origin in ascendants becomes, at last, hereditary in descendants. Apparently, its solution will be found in the facts of the maleficent consequences of urbanization in human stocks, which escape extermination by degeneration and disease, and the variations or adjustments which ensue, whereby acquired immunity is attained; and similar facts concerning the consequences of the long continuance, over generations, of other unfavorable environment, such as insufficient nourishment, malaria, the hookworm, and food deprived of some element necessary to nutrition, or so mistreated as to be relatively poisonous. It may become demonstrated by subjecting short lived animals to definite, unfavorable environment, for twenty, or more, generations, and observing and correlating the facts thus obtained. Facts from biology, as to species of animals and plants subjected for generations to inimicable environment, will also aid in the solution. (2) The eradication of degeneracy and its prevention, will probably find its solution in the development of euthenics, and in the segregation, or the sterilization, of individuals manifesting the more marked degrees of degeneracy — more especially of the hereditary types.

DEPARTMENT OF TECHNIQUE

TREATMENT OF INFECTED GUNSHOT WOUNDS

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IN treating infected wounds, the following resources are employed in the American Hospital in Vienna:

1. Removal of infected bits of clothing, or other infected foreign matter.
2. Wide incision and drainage.
3. Immobilization.
4. Continuous irrigation by the drop method with Dakin's solution of sodium hypochlorite, or continuous immersion in hot antiseptic solutions, as acetate of aluminum.
5. Stimulation of lymph drainage with Wright's solution of sodium citrate 1 part, sodium chloride 4 parts, and water 95 parts.
6. Regular and prolonged daily exposure to the rays of the sun.
7. Continuous exposure of all wounds to the air without dressings whenever possible to avoid foreign body reaction.

We have not made use of Clumsky's solution of camphor and phenol.

Small superficial slightly infected tangential wounds are rinsed with normal salt solution or hydrogen peroxide and covered with peru balsam, or Mickulicz salve.

Of these agents those which have proved of greatest value, are:

a. Solar therapy.

b. Open treatment without dressings to promote drying and to prevent foreign body reaction.

c. Continuous irrigation with sodium hypochlorite solution, composed of dry sodium carbonate, chlorinated lime, boric acid, and tap water.

Naturally the method of treatment and the agents to be employed in each case are determined by the nature of the infection and the character of the wound. For our own convenience we have made the following simple classification:

Group 1. Deep wounds with small openings, which provide poor drainage. These result usually from impacted rifle or shrapnel balls.

Group 2. Large lacerated wounds involving deep muscles or bone, caused usually by fragments of bombs, shrapnel or grenade casings and dumdums.

Group 3. Large and small shallow or crater-like superficial wounds due to tangential shots or impact of boulders and large superficial granulating wounds following incision for phlegmon.

In Group 1 the wounds are excised or enlarged to afford proper drainage and at the same time to permit of the removal of bits of uniform, grenade fragments or pieces of bone. If a limb is involved, an immobilization splint is then applied. During the day the wound is exposed for hours to the rays of the sun, and at other times is irrigated, or covered with a wet dressing of Dakin's solution. In deep and extensive infections we have secured excellent results by immobilizing the part with a splint in such a manner as to leave the wound quite exposed. A rubber drainage tube is inserted to the bottom of the wound and the tube connected with a large receptacle, containing warm Dakin's solution. The solution is allowed to flow into the wound by the continuous drop method as suggested by Carrel. A large hot wet dressing of gauze soaked in Dakin's solution and changed twice daily may be applied with advantage around the drainage tube.

As a rule in less than a week the discharge of the pus ceases even in the most active and serious infections, and the wound surface is covered with healthy granulation tissue. Foul odors disappear with surprising promptness under the treatment with the sodium hypochlorite solution.

Serious and deep infections receive, in addition to the continuous irrigation and the open wound treatment, prolonged daily exposure to the rays of the sun. In superficial wounds solar therapy and open treatment are especially efficacious. Foreign bodies are prevented from coming in contact with the wound by means of square windows or frames cut out of cardboard and made at least one centimeter thick by rolling crepe

paper about the cardboard squares. This protective frame is placed around the wound and secured in position with adhesive plaster. Foreign-body reaction is thus reduced to the minimum. Schumm, who suggested the cardboard window, has likewise prevented contact of dressings with the wound by the use of small wire baskets or cages likewise secured in position with adhesive plaster.

The open treatment of infected wounds as recommended last winter by Braun and since employed in German and Austrian Military Hospitals by Walzel, Loercher, and others has in several hundreds of our cases proved of distinct and superior value. The actual healing factor in open treatment is still a subject of discussion. Walzel believes the benefit to be due chiefly to the drying out of the wound, and condemns the old-fashioned clump dressing as a breeding nest of bacteria. Schlossmann looks upon the oxygen of the air and the drying of the tissues as important factors in preventing the growth of anaerobes. Many have spoken of the damage done to granulations by the frequent changes of gauze dressings. Braun especially deprecates the painful changing of dressings, and Walzel as well as many other surgeons has been impressed with the advantages of frequent or practically continuous observation of the wound made possible by open treatment. Naturally also the great saving of dressing material is of considerable moment in all military hospitals. In our institution we have become convinced that not the least of the virtues of open wound treatment lies in the prevention of foreign body reaction. Every surgeon is familiar with the phenomena induced in the tissues by the presence of foreign bodies, such as gauze, drainage tubes, and ligatures. Whether by a process akin to chemotaxis, or by response to physical trauma, or what not, it seems certain that not rarely wound secretion is continued by foreign bodies such as gauze or drainage tubes introduced to absorb it or carry it off —*Ubi stimulas ibi fluxus*.

Large superficial granulating wounds entering the hospital from the transport are as a rule covered with bandages necessary of course for the trip in the transport train. They are usually bathed in a copious, purulent or seropurulent, foul smelling discharge. Such wounds when treated by the open air method often become dry in less than twenty-four hours. The granulations freshen, and epitheliazation progresses rapidly. This is especially true of cases in which the open wound treatment is augmented by exposure to the rays of the sun. The patients themselves prefer the open treatment with its absence of hard dry dressings rubbing against sensitive surfaces, and without adhering gauze which tears loose granulations and young epithelium when bandages are removed. We have had no cases of secondary infection due to open treatment, and no difficulty in the matter of carrying away discharges. A rubber sheet drains the discharge into a receptacle at the bed side. It is interesting to note that after a few days of open wound treatment the rubber sheet is as a rule no longer necessary.

The solar rays considerably hasten the drying of secretions and add to the stimulation of epithelial growth. They moreover inhibit the growth of many pyogenic bacteria and the contaminating saprophites. During dark rainy days there may be little or no improvement in the condition of infected wounds, but when the sun shines and the patients are sent to the garden with the wound exposed to the sun a few hours each day improvement is prompt and unmistakable. We have regulated the time of exposure according to the comfort of the patient, or according to the degree of chemical erythema, or hyperæmia of the adjacent skin. Wounds are at first exposed directly to the sunlight with no covering whatsoever. If smarting or burning begins, or the adjacent skin becomes decidedly hyperæmic, the wound is covered with a single or double layer of gauze laid upon a wire basket. We have had no complaints from patients undergoing sun treatment, and have observed no ill effects.

As the Reserve Hospital is much less a research institution than one for the most expeditious relief of suffering and restoration to service, we have not excluded other methods of antiseptic wound treatment in the attempt to establish the value of open and solar therapy in our cases. Although dependence has been largely placed on sunlight and open treatment, together with Dakin's solution for continuous irrigation, frequent use of hot baths in solutions of older and better known antiseptics has been made. Continuous hot baths in solutions of bichloride of mercury, permanganate of potassium, acetate of aluminum, and physiologic salt have been used with gratifying results in all varieties of infected gunshot wounds. Continuous immersion lends itself especially to injuries of hands and wrist or feet and ankles, as does continuous irrigation to the other parts. As a rule hot baths allay pain better than sedative medicines. The hot bath in Wright's solution is especially useful in those cases in which it is desirable to stimulate lymph drainage, as in cases of diffuse hard cellulitis.

The resources for the treatment of infected wounds as mentioned above have been employed regularly in the treatment of amputation stumps. After amputations in serious infections of the extremities, open treatment of the wound has been the rule. The guillotine or flapless amputation of Fitzmaurice-Kelley originally recommended by Van Buren Knott has not been employed. We have had so much difficulty in pulling the skin down over the wound surface in amputations without flaps done elsewhere that it has seemed wiser to cut short flaps and leave them wide open, to be closed with adhesive plaster straps after the danger of infection has passed.

ILLUSTRATIVE CASES

CASE 1. Service of Dr. Bettman.

Wounded in the thigh July 2. Operated upon two days later and metal splinters removed. Re-operated on three days later because of gas infection. Admitted to Reserve Hospital No. 8, July 23, with three large wounds of the thigh. These were superficial to the musculature. The entire epithelial and fascial covering was destroyed. The largest wound was about ten inches long and about four inches wide at its greatest width. The other wounds were of about one-half that size. Except for the commonly found soft systolic murmur, the physical examination was negative. On removing the bandage, the surfaces were found covered with a thick, heavy, purulent, and very offensive discharge. The wounds looked very unhealthy. Granulation tissue was present but pale and œdematous. The wounds were washed with permanganate of potassium solution and sterile gauze dressings were applied. The following day the wounds were *in status idem*. For about four days treatment as above was carried out with little or no improvement. On the fifth day the patient was placed in the garden and the wounds exposed to the sun. When they were rebandaged the bandages were kept from coming in contact with the wounds by means of gauze rolls placed alongside. Within three days there was great improvement. The wounds had become almost dry. The discharge was watery and had lost its foul odor. Epitheliazation had progressed noticeably. The granulations had almost entirely lost their œdematous appearance. Now, three weeks later, the wounds are nearly healed except the largest one, which is still about 5 inches long and about one inch wide. This case is an excellent example of sunlight therapy. Due to the location and size of the wounds it was almost impossible to protect them from contact with the bandages and after the second day they were bandaged in the usual manner. After several hours of sun exposure the wounds were so much dryer that each morning there was but a slight watery discharge.

CASE 2. Service of Dr. Dunn.

Patient 42 years old, butcher by trade and very strong physically. He had been in the field seven months when wounded on July 27, by shrapnel which laid the left knee-joint open. The patient was treated in the field hospital with dry dressings and came to the Reserve Hospital No. 8 on the tenth day of August with the left lower extremity in a starch bandage. The odor was very foul so that other patients could not stay in the same ward. On August 11 the starch bandage was removed and the wound examined. The leg was almost completely disarticulated at the knee, the patella hanging in a mass of granulation tissue. The articular surfaces of both femur and tibia were intact, but the cartilge was eroded by the acute infection. There were immense flaps of connective tissue overhanging the knee-joint. The wound was secreting large quantities of foul smelling pus, which contained streptococcic chains and a few thick short bacilli. The lower leg was attached to the thigh posteriorly by a thick flap of granulation tissue which contained the popliteal vessels. The soft parts of the lower third of the thigh were represented by a lacerated mass of infected tissue so that it would have been impossible to amputate except by the guillotine method quite high up. A hooped plaster bandage was applied leaving the wound exposed. Continuous irrigation with Dakin's solution by the drop method was employed, and on August 12 the offensive odor had disappeared and there was very little discharge. During the next week there was a large growth of granulations with walled-off pockets of pus. These were mechanically broken open to allow entrance of the Dakin's solution. From August 22 to 25 there was no pus or foul odor. Amputation was done by the short flap method between the middle and lower third by Drs. Oberembt and Dunn on August 26. On September 5 the wound had closed firmly by first intention.

CASE 3. Service of Dr. Rueth.

Patient was wounded July 15, 1916, by rifle bullet entering the left arm, lodging in the humerus and fracturing the same. He was treated in the field hospital by dry dressing over the aperture of entrance of the bullet and immobilization of the arm with a posterior splint. He came with a transport to the Reserve Hospital No. 8, August 2, with the following findings: He complained of severe pain in the upper left arm and shoulder and was very weak. Upon removal of the bandage and splint it was found that the arm, shoulder and anterior axillary fold were swollen, hard and inflamed, and that the wound of entrance was closed. Temperature 102°, pulse 120. Hot moist dressings were applied and patient was put to bed. The dressings were changed every three hours. The next morning the patient was taken to the operating room. The wound of entrance was re-opened, another opening made lower down in the arm and two through-and-through rubber drains were inserted. About 500 cubic centimeters of pus was expelled from the wound. Hot moist dressings were applied and changed twice daily for a week. The discharge did not decrease. The patient had a normal temperature mornings, but an afternoon and evening rise of several degrees. Through-and-through irrigations with Dakin's solution was then begun. The temperature became normal and the patient began to feel much better. Within a week the discharge of pus had ceased.

CASE 4. Service of Dr. Schumm.

Patient was wounded early in the morning of June 27, 1916, on the Italian front, by the explosion of a mine. He suffered a small laceration of the right thigh caused by impact of a boulder. The next day the leg became painful and swollen and the patient became feverish. On June 29, 1916, the case was diagnosticated as gas phlegmon and several long longitudinal incisions were made in the thigh and the calf of the leg. The patient was transferred to Reserve Hospital No. 8, July 25, 1916. On admittance the patient had two large superficial wounds, one 17 centimeters long and 5 centimeters wide, and the other 15 centimeters long and 3 centimeters wide, on the outer surface of the middle and lower thirds of the right thigh. On the inner surface of the thigh was a third wound, 12 centimeters long and 3 centimeters wide. All were covered with strong granulation tissue and were discharging large quantities of thick greenish-yellow pus. On the inner and outer surfaces of the calf of the right leg, extending from just

below the knee downward, were two similar wounds, one 9 centimeters long and 2 centimeters wide and the other 9 centimeters long and 3 centimeters wide. For the first four days the wounds were exposed to the rays of the sun during the morning, and at night were covered with hot moist dressings of Dakin's solution. At the end of four days the discharge of pus had ceased and cardboard windows were placed about the wounds to prevent contact of dressings with the wounds. Treatment by heliotherapy was continued. On August 17, the wounds were entirely healed.

CASE 5. Service of Dr. Bettman.

Three weeks before admission patient was injured by a rifle bullet passing through the hand. One week after the injury, a small incision was made to evacuate pus. On admittance to K. u. K. Hospital No. 8, the left hand was found to be greatly swollen and extremely tender. There was no motion of the wrist or fingers without great pain. On the dorsum was a large ragged open wound, discharging thick, foul smelling pus. With a probe, bone fragments were discovered just under the skin. The skin of the palm was entirely missing and replaced by a granulating surface. X-ray showed a destruction of all the carpal bones except the triquetrum, pisiform and lunaris. There was a fracture of the second metacarpal, and splintering of the third and fourth metacarpals. The patient was first treated by hot moist dressings, but as these did not relieve his pain, the hand was given continuous immersion in hot permanganate solution, for three hours each morning and afternoon, with hot moist dressings in the intervals. Pain persisted for about a week with occasional fever, after which there was very little pain and no fever. A small red fluctuating mass formed a week later and this was lanced, otherwise there was no operative procedure. On admittance this man looked very sick, septic, and icteric. Two weeks later he looked and felt well, and could move wrist and fingers. The palm had entirely healed and the dorsum healed except for two small discharging sinuses.

A METHOD OF RE-ESTABLISHING THE PATENCY OF THE URETER IN PYONEPHROSIS

PRELIMINARY REPORT[1]

BY MARTIN MOLONY, M.D., SAN FRANCISCO

THE object of this paper is to bring before you in as concise a manner as possible a method of restoring the patency of the ureter in cases of hydronephrosis and pyonephrosis. A few preliminary remarks are presented as to the cause of pyonephrosis, especially as the cause appertains to the class of cases for which this method is suitable.

Broadly speaking there are two forms of pyonephrosis. The one is secondary to hydronephrosis and is very frequently associated with movable kidney or calculi. The obstruction is usually high up in the ureter, the infection being an ascending one from cystitis, or it may be hæmatogenous. The other form of pyonephrosis develops in connection with pyonephritis, is frequently due to disease in the lower urinary tract, and is often associated with enlargement of the prostate, stricture, or bladder growths. These latter cases therefore occur more often in

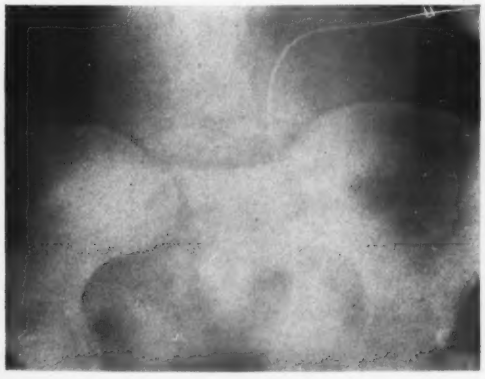

Fig. 1. Shows a large catheter with a large stillette passed through the left kidney and ureter.

Fig. 2. Same catheter filled with collargol solution.

[1] Read before the American Urological Association, St. Louis, 1916.

men, are frequently bilateral, the whole ureter being dilated. The former variety is more common in women and usually unilateral, and dilatation of the ureter occurs only above the obstruction. The condition of the pyonephrotic kidney has to be considered, whether the amount of injury done to the renal tissue is small, or whether the functional power of the secretory tissue of the kidney is totally destroyed. The condition of the second kidney is of prime importance and sometimes difficult to ascertain accurately. The exclusion of pyonephritis and tuberculous pyonephrosis by clinical and bacteriological methods is also necessary. Cystitis will often obscure your diagnosis. The treatment in those cases of pyonephrosis has been mostly confined to the question of nephrotomy or nephrectomy and a great many hold that the radical operation is the only one.

In making a very brief search of the literature on pyonephrosis, it is amazing how little is published on the subject. There is an interesting review on congenital stricture of the ureter by Bottomly in the *Annals of Surgery*, 1910. He defines a stricture in its wide sense as any narrowing of the ureter. The great majority of the cases quoted by him refer to children; but how do you explain the delay in development until adult life, of obstruction in the ureter when the cause is evidently congenital?

Many dispute the point that a great number of these cases are congenital. The operative results on obstructive conditions of the ureter and pelvis are not very encouraging. Cabot states in a collection of cases operated on for renal and ureteral calculi, that almost 50 per cent of the cases were not well after operation and that the majority of these unsuccessful ones were due to recurrent calculi. Many other statistics of a similar nature can be quoted. From the results gleaned in various operative procedures for congenital and acquired malformation of the ureter and renal pelvis 30 to 40 per cent are failures. Some surgeons report as high a rate as 50 per cent. Nephrectomy was often a secondary measure after the failure of other methods. The loss of a kidney is a severe penalty and its removal is frequently a great risk if the function of the other kidney is impaired.

The history of a case follows:

Woman, age 36. As a girl she was always thin and delicate and remembers having some trouble in urination. Ten years ago she was told she had a right movable kidney. She was frequently troubled with cramping pains which she ascribed to flatulence. Two years ago during pregnancy she had much trouble with frequency and painful micturition which improved after the birth of the child. One year ago the symptoms began to get worse until about three months ago when the pain became very severe with incessant straining on urination, and there was thick ropy pus in the urine and sometimes blood.

When she came under my care she had chills and fever, temperature ranged from normal in the morning to 103° in the evening; urination every ten minutes. Examination showed right kidney very movable, not enlarged and not tender on palpation. Left kidney slightly movable, tender on palpation, slightly enlarged, patient very emaciated with severe night sweats. Cystoscopy under gas and oxygen. The interior of the bladder looked like a mud pool with blood, pus, shreds, and débris. After some difficulty both ureters were catheterized. Right kidney, urine clear, contained bacilli coli; thick creamy pus, about one ounce. The left kidney was washed out with silver nitrate and permanganate of potash. The temperature dropped and the pus diminished but the value from this procedure was of short duration. In a few days the pus and temperature increased again. The condition of the patient was becoming critical, with weak and rapid pulse. Nephrostomy was performed and drainage tubes inserted after loculi and septa were broken down. There was a fair thickness of renal tissue and no apparent indication of tuberculosis. The patient made slow progress at first and after some days it was decided to try to restore the patency of the ureter. A catheter was passed into the kidney with the aid of the cystoscope and brought out through the nephrostomy wound on the loin. To the point of this was sewed a No. 11 catheter. After removing the cystoscope, traction was made on the small catheter bringing the large one down through the kidney and bladder and out through the urethra. The catheter was drawn out as far as possible so that the largest diameter of it was in the pelvis and upper portion of the ureter. Six or eight inches of the tip of the catheter were cut off close to the urethra and a strong plaited silk ligature was attached to the cut end. By pulling on the upper end in the wound the lower end was drawn up into the bladder with the plaited silk ligature hanging out through the urethra. This piece of silk ligature caused no irritation in the urethra which the catheter would have done. It also gave control from both ends when it was necessary to move the catheter up or down and adjust the lower end of it so as not to irritate the neck of the bladder. The catheter in the kidney, the ureter and bladder caused no inconvenience whatever, and the bladder was irrigated with solutions daily by inserting the nozzle of an irrigator into the upper end of the catheter projecting out of the wound. The large catheter was changed every few days by inserting an extra long wire stilette through it, withdrawing the catheter and inserting a fresh one over the stilette. The size can be increased to fifteen if necessary, as in this case the ureter was easily dilated to a large size. The catheter was removed after three weeks. The patient increased in weight and vigor and was able to go about soon after the catheter was removed. By inserting the nozzle of an irrigator into the fistula a pint of solution could be run through into the bladder in a few minutes thus proving the patency of the ureter.

The treatment of associated conditions is necessary to aid in obtaining a finally good result. When you have a condition with movable kidney a nephropexy should be performed at the time of operation.

Another matter that requires attention is this: Where a chronic cystitis is present, as regurgi-

tation takes place through the dilated ureter from the bladder to the kidney it is necessary to treat the bladder and urethral conditions frequently found in these cases as described in my article in the *California State Journal of Medicine*, January, 1915. Otherwise infection will be carried up from the bladder to the kidney and will cause delay in healing of the renal fistula. It would be interesting to know the exact pathological conditions existing one or more years after dilatation by this method. We know from experience that for a month after, the ureter remains quite patent and that you can run more fluid through it to the bladder at a rate with which no kidney could compete, so that if it does this for a month it should be fairly good for years after. This is a simple and efficient method of dilating strictures, of straightening kinks due to a movable kidney or obstructions due to adhesive bands or aberrent arteries, with the prospect of a more permanent result than is to be obtained from the numerous operative procedures introduced for these conditions. Obstructions at the vesical orifice due either to stricture or prolapse of the ureter into the bladder (cystic protrusion of the ureter) can be treated by perforating or slitting open and dilating through the operating cystoscope instead of adopting the open surgical methods formerly recommended. I have opened a cyst with the Oudin current, making a good wide slit in it, and with dilatation it remained open for months afterward while the case was under observation. This method of course does not apply to impermeable ureters which are extremely rare, even in many of the so-called congenital cases. Tubercular conditions are naturally excluded. The following results are obtained from this method:

Patency of the ureter is re-established.

Very irritable and sensitive bladders are kept washed out through the kidney.

A patent ureter with good drainage as a necessary preliminarv to healing the renal fistula, is assured.

ENTEROPLASTY FOR THE RELIEF OF SIGMOID OBSTRUCTION

By W. FRANK FOWLER, M.D., Rochester, New York

THE writer lays no claim to originality for a method which has probably been utilized by others in like emergency. However, he is not aware that a description of the operation has ever been published.

Mr. W., age 69 years, was seen April 17, 1916, in consultation with Dr. E. B. Chapman in Brockport, N. Y. *Previous history.* An attack of pneumonia, when a young man, has been the only serious illness. There was nothing significant in his history except, possibly, a slight hæmatemesis which occurred 15 years ago. The bowels have always been regular.

Present illness. About April 3, 1916, he began to be troubled with constipation which would not yield to ordinary catharsis. This condition gradually grew worse until constipation became nearly absolute. At first very slight result could be obtained from enemata. Flatus was expelled infrequently and in small amounts. There

Fig. 1. Showing stricture of sigmoid opposite sacral promontory.

Fig. 2. Showing enlargement of rupture by longitudinal incisions along free border of the sigmoid.

Fig. 3. Showing approximation of upper and lower incisions by through-and-through linen suture.

Fig. 4. The lumen has been restored in the anteroposterior plane. The reinforcing seroserous suture is shown.

was occasional vomiting during the first week which apparently became stercoraceous and then ceased entirely. There was loud gurgling in the intestines and gradually increasing abdominal distention. He ate very little but was up and about much of the time with remarkable freedom from discomfort. Later numerous attempts to evacuate the bowels were ineffectual. The rectal tube met obstruction at a definite point.

Physical examination. The patient was a well nourished man in bed, perfectly rational and comfortable. The tongue was coated and dry, the abdomen enormously distended and tympanitic. The temperature was 99° F., the pulse 88 and the respirations 26.

Operation. A median incision was made below the umbilicus. Greatly distended loops of small bowel presented in the incision. The lesion consisted of a benign stricture of the sigmoid. Cicatricial contraction had sharply drawn down a limited area of the free border of the bowel leaving an extremely narrow lumen as indicated in Figure 1. The sigmoid was brought up without great difficulty but traction incident to delivery into the incision caused rupture at the constricted point. Resection seemed an unduly formidable procedure and after a moment of reflection the following method was utilized: The small rupture was enlarged by 2 incisions in the long axis of the bowel, one extending upward toward the descending colon, the other downward toward the rectum, the length of each corresponding approximately to the normal diameter of the gut as shown in Figure 2. The longitudinal slit was transformed, in effect, into a transverse union by bringing together corresponding points of the upper and lower incisions with a through-and-through linen suture and a reinforcing seroserous suture, also of linen. Insufficiency of bowel tissue at the point of constriction precluded a typical transverse plastic repair as exemplified by the Heinecke-Mikulicz pyloroplasty. The lumen was therefore restored in the plane of the mesenteric and free borders (Figure 3), rather than from side to side.

This anteroposterior restoration is the feature of the operation which justifies its description. Approximation was accomplished without undue tension or kinking. A rectal tube was passed beyond the line of suture, a rubber tube inserted down to the sigmoid through a stab wound and the median incision closed. The operation was well borne.

Postoperative course. The tube was forced out of the rectum by a loose evacuation a few hours after operation. The tube was replaced but was again forced out the following day and was not again replaced. The bowels continued to move loosely each day. Although no ill effects followed the ejection of the tube, nevertheless the writer believes that it should have been retained in its position by a transfixion chromic gut suture as suggested by Heyd (1). The present condition of the patient is excellent. The bowels move normally once a day.

Wiener (2) mentions seven operative methods for the relief of sigmoid and rectal strictures and delineates an interesting original procedure. Werelius (3) describes an ingenious operation which he employed for the relief of a benign stricture of the small intestine. The stricture was folded upon itself and a lateral anastamosis of the bowel above and below the constriction was made with clamps after the manner of performing gastro-enterostomy. The writer considered and abandoned this procedure because of the complicating rupture and a doubt that the mesosigmoid would readily lend itself to such manipulation in this particular case. The just claims of Werelius of lessened operative time, non-interference with the blood supply and freedom from technical difficulties apply in equal degree to the operation herein described.

CONCLUSIONS

1. Each case of intestinal obstruction is an individual surgical problem.
2. Two rows of permanent sutures may be required to insure union in an infected field.
3. The possibility of rupture at the strictured point must not be overlooked.

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2. Wiener. Surg., Gynec. & Obst., 1915, xx, 222.
3. Werelius. Surg., Gynec. & Obst., 1912, xiv, 384.

INTRANASAL TREATMENT OF FRONTAL SINUSITIS[1]

By R. H. GOOD, M.D., Chicago

TEN years ago the rhinologist experienced considerable anxiety whenever he was called upon to treat a case suffering with frontal sinusitis, but today on account of the advent of intranasal surgical methods, he is able to cope with this disease with no more anxiety than he has in treating an antrum or ethmoidal sinusitis. Nine years ago when my first publication appeared in the *Journal of the American Medical Association*, I received criticisms such as "the impossibility of getting into the frontal sinus with the rasp," "too much danger of meningitis," "establishing inadequate drainage," "operation only possible in small percentage of cases," "indicated in small percentage of cases," "impossibility of effecting a cure," etc., but all those criticisms came from those who had no experience in intranasal surgery of the frontal sinus. At this date it is unnecessary to waste time or ammunition to persuade the rhinologist to adopt the intranasal operation as its advantages are apparent to all and the operation is being quite universally adopted.

In this country it is a serious matter to disfigure a patient's face, especially in the region of the forehead where the movements of the orbicularis frontalis muscles become impaired, and thereby paralyzes the patient's facial expressions, so necessary in orators, singers, and stage performers.

The external operation usually severs the supraorbital nerve, which in addition causes numbness and parasthesia of the forehead and scalp. The danger of meningitis in the external operations which establish drainage through the nose is equal, if not greater, than in the intranasal operation where the rasp is employed. The external operation frequently requires months of dressings and bandages and prevents the patient from returning to his usual occupation during this period. Furthermore, the external operation does not by any means always result in a cure. In my travels in Europe I saw more secondary than primary external frontal sinus operations. While I was a student a friend of mine was operated on twelve times externally by two eminent surgeons, which did not result in a cure and the disfigurement was very marked. My knowledge of this case augmented my determination to operate on the frontal sinus intranasally.

I know of patients who were allowed to suffer for months with frontal sinusitis resulting in serious complications just because the rhinologist hesitated to disfigure the patient or because the patient refused to be scarred. I am now of the opinion that every case of frontal sinusitis requiring operation should first have an intranasal operation, as it gives one additional knowledge of the condition inside of the sinus. If an external operation becomes necessary the ethmoidal cells are then already removed, and an ample drainage established from the sinus into the nose. I consider the removal of ethmoidal cells from the frontal sinus route poor surgery as compared with the nasal route. In cases with intracranial complications both the intranasal and external operation should be performed at the same time and the dura exposed.

I am of the opinion that performing an external operation today without first employing the intranasal method shows lack of knowledge and poor judgment on the part of the surgeon.

It is eight years ago that I published my last article in the *Laryngoscope* on the intranasal frontal sinus operation, and having simplified the operation greatly as well as having more experience I thought best to write an article for publication in response to the invitation received from your society. I published an article on acute "Frontal Sinusitis" last year in the *Illinois Medical Journal* which takes up the etiology, symptoms, and diagnosis. Time does not permit us taking up this phase of the subject.

The majority of frontal sinusitis cases get well with ordinary treatment, such as the patient spraying the nose with 1 per cent solution of cocaine in adrenalin chloride 1:5000 morning and night. The nose should be sprayed about three times, allowing a minute to elapse between each spraying. The patient should be instructed to blow the nose real hard, by keeping the nostrils closed with the fingers and immediately thereafter make strong suction by negative respiration with the nose kept closed. This should be frequently repeated for an hour after the spraying.

Once a day the patient presents himself at the office where the rhinologist may apply into the middle meatus a 10 per cent solution of cocaine in adrenalin chloride 1:1000. Ten minutes after the application, suction should be made by any of the suction devices, with the patient in the

[1] Read before the Milwaukee Oto-ophthalmic Society, May 16, 1916.

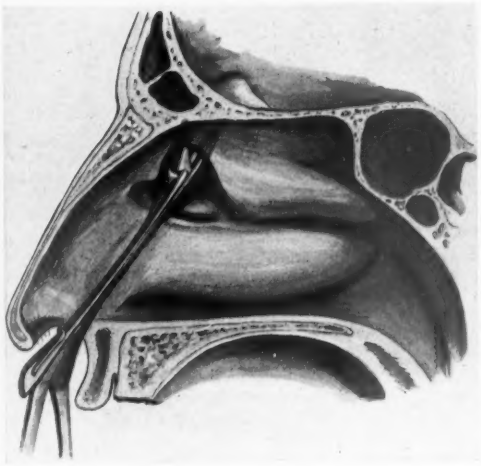

Fig. 1. Forceps biting out anterior end of middle turbinate.

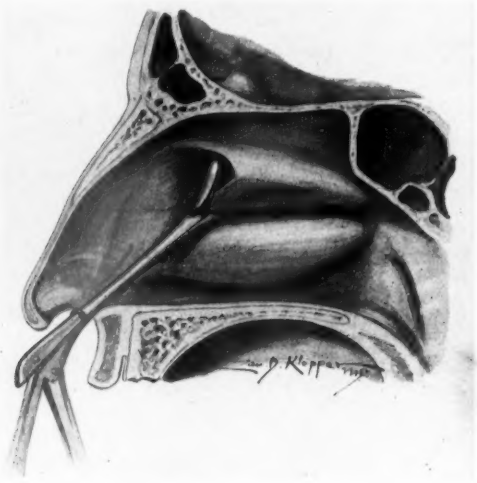

Fig. 2. Biting forceps biting out anterior ethmoidal cells.

erect position. The suction is more efficient if one uses a vibrator over the sinus while suction is made. Anesthone cream applied into the nose several times daily when the patient is in the recumbent position is beneficial in keeping the nose open and has no toxic effects. Aspirin in ten to fifteen grain doses three to four times a day is very valuable in acute cases. Calomel followed by a saline should be administered every second day. In severe cases I am in the habit of prescribing ten grains of urotropin every six hours, but I am not convinced that it does very much good. If the sinus can be catheterized easily without trauma, daily lavage is excellent treatment, but, if the tissues have to be traumatized each time, it will do more harm than good.

If the above-described treatment fails to relieve the patient, one should open the anterior ethmoidal cell until a good sized cannula can be introduced into the sinus.

If the middle turbinate is large the anterior end should be removed. In my experience the removal of the anterior end of the middle turbinate alone does very little good unless one can easily pass a cannula after so doing. It is my rule now never to be satisfied with just removal of the anterior end of the middle turbinate, but I open enough ethmoidal cells to enable me to lavage the sinus. This will cure the great majority of cases without further operation, provided one has not waited too long before operating. It stands to reason that early drainage gives the best results, the same as early incision of the drum membrane results in the earliest cure, simply because there is not enough time elapsed to allow serious pathology to set in.

Failing to relieve my patients with the aforesaid methods, I proceed to perform the intranasal frontal sinus operation with the rasp.

X-ray pictures are a great aid in determining the size of the sinus, but the stereoroentgenogram is a marvel, as one can see into the sinus and outline its depths. Unfortunately but few have learned the art of making these successfully, so that as yet it cannot be universally employed. I consider transillumination of great value and should never be omitted.

The statement is frequently made that many anatomical specimens show small sinus so that an intranasal operation cannot be performed. We must, however, bear in mind the fact that it is the large sinuses which become diseased most frequently, due to the fact that they secrete much more mucus than a small sinus and therefore have more difficulty in emptying themselves. My experience is that a very small frontal sinus rarely needs surgical interference, and I have yet to get my first case of suppurative frontal sinusitis where I failed to get up into the sinus.

Cases of sinusitis with œdema or subperiosteal abscesses or orbital abscesses or fistulæ should be operated on at once.

Fig. 3. Rasping out ethmoidal cells all the way up through floor of frontal sinus. The smooth lateral surface of the rasp hugs the orbital wall.

Fig. 4. Shows possibility of rasping without injury to cribiform plate of ethmoid or internal plate of the skull as the posterior surface of the rasp is smooth.

In cases of catarrhal sinusitis and acute suppurative sinusitis requiring operation, it is my custom to rasp out the anterior ethmoidal cells all the way up into the floor of the frontal sinus, and if this establishes a fair sized opening which it usually does I refrain from rasping much of the nasal spine.

In suppurative cases with orbital abscesses I make a larger opening by rasping away some of the frontal spine, and then I make an opening through the lamina papyracea of the ethmoid and drain the orbital abscess through the nose. It is, however, not always easy to drain a large orbital abscess in this manner, because the pus at times penetrates the peritoneum of the orbit so that it is often necessary to make an external incision into the abscess cavity to drain it.

I open the orbital abscess at its most prominent point usually above the inner canthus of the eye. In chronic suppurative frontal sinusitis the opening is made larger by rasping away the frontal crest or spine.

Fistulæ will begin to close of their own accord immediately after the operation has been performed providing good drainage has been established. It is self-evident that osteomata, frontal sinus cysts, osteomyelitis, and tumors of the sinus cannot be considered as frontal sinusitis, and external procedures are necessary. While it is true that Schaffer in 1890 and Spiess in 1899 did some work approaching intranasal frontal sinus surgery, it was, however, far remote from being a real frontal sinus operation.

Dr. Ingals in reality is the pioneer in this work and had it not been for him we would no doubt still be groping in darkness so far as the intranasal surgery on the frontal sinus is concerned. It revealed the possibility of getting into the sinus with a drill by way of the nose. Dr. Halle deserves the credit of operating on the frontal sinus intranasally under the direction of the eye with a burr. Somehow I could not convince myself that a burr was a safe instrument, and I was afraid to use it because of the difficulty of controlling a rapidly revolving burr on a long handle. It was this fear that lead me to think of another method.

In my boyhood days we used coarse horse-hoof rasps made by hand, and it was from this rasp I conceived the idea of making a rasp to rasp out the ethmoidal cells and the frontal crest.

I have greatly simplified the operation by discarding the chisels and the protectors so that I consider it feasible to describe again the operative procedure in detail in this paper.

Anæsthesia. It is now my practice to give the patient, thirty minutes before operating, a quarter grain of morphine hypodermically. With a cotton applicator saturated in adrenalin chloride 1:1000 and then dipped into flaky cocaine, the

Fig. 5. Biting forceps.

entire ethmoidal region is thoroughly anæsthetized by rubbing the applicator repeatedly over the membrane. A 1 per cent solution of novocaine may be injected subcutaneously in the region above the inner canthus of the eye. In seven minutes I proceed to remove the anterior end of the middle turbinate (Fig. 1) and bite out the anterior ethmoidal cells with a biting forceps (Fig. 2) as follows: The forceps enters the ethmoidal labyrinth through the bulla, biting an opening through the labyrinth upward, outward, and backward to the base of the skull, always bearing in mind that the forceps must hug the orbital wall which is the guide. This opening is approximately in the region between the anterior and posterior ethmoidal cells. Care must be taken not to injure the inner boundary of the ethmoidal labyrinth which is the inner vertical plate and descends from the under surface of the cribiform plate and lies to its outer side above and terminates below in the free margin of the middle turbinate bone. By removing the ethmoidal cells without removing this plate, we know that we have not injured the cribiform plate, because this structure lies internal to the inner vertical plate of the ethmoid. The rasp (Fig. 6) is now inserted into this space made by the forceps as indicated in (Fig. 3) and all the cells anterior to it are rasped out all the way up through the floor of the frontal sinus. The smooth lateral surface of the rasp hugs the orbital wall which serves as our guide. In this way the cells which creep over the orbit can be rasped away, and this is of great importance in making a large opening into the frontal sinus. The tip of the rasp (Fig. 6) is smooth and slides along the floor of the skull. We now pass a cannula into the frontal sinus and squirt a 10 per cent solution of cocaine in adrenalin chloride 1:1000 into the sinus. In a few minutes we can proceed to rasp away some of the frontal crest. It is frequently possible to apply cocaine with an applicator to the crest after the ethmoidal cells are thoroughly removed. At this stage of the operation we are entirely anterior to the cribiform plate of the ethmoid, and we can rasp without fear of injuring this structure or the internal plate of the skull (Fig. 4) as the posterior surface of the rasp is smooth. The agger cells are rasped away in this procedure and I do not know of a single case where these cells caused me any trouble whatever after the operation.

There is some danger of rasping through the orbital wall, even though the orbital surface of the rasp is smooth, but one can determine this readily by placing the finger externally in the

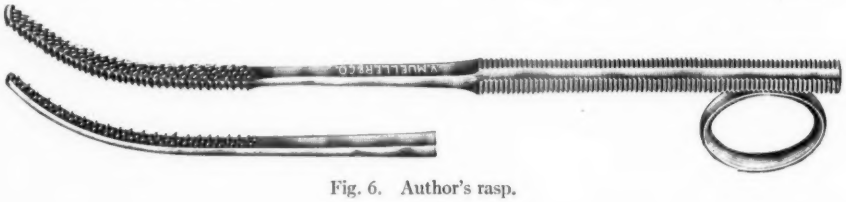

Fig. 6. Author's rasp.

region above the inner canthus of the eye while rasping. There is little harm done by so doing but there is nothing gained. There is no danger of injuring the lachrymal duct as this structure lies below the field of operation. By this method of operation we need not ask ourselves the question where the frontal duct lies, or whether any ethmoidal cells lie external or anterior to the duct, as these are all removed including the duct itself, and the posterior wall of the ethmoid cells which were in the floor of the frontal sinus form the posterior boundary of the new osteum frontalis created by the operation.

Luc's ethmoid forceps (Fig. 7) is very useful to remove the broken down cells caused by the rasp.

If there are soft granulation masses in the floor of the sinus I attempt to remove them with flexible ring curettes, but I have given up the attempt of reaching the remote areas in the sinus, as one at best must work in the dark. In case the septum is deflected to the diseased side, it is necessary to do a submucous resection to enable us to approach the ethmoid cells.

It is my practice immediately after operating to apply tincture of iodine to the frontal sinus and ethmoidal region as an additional precaution against infection.

The patient should be cautioned not to blow the nose hard during or immediately after the operation as air may be forced through the lamina papyracea into the subcutaneous tissues around the eye. This causes enormous swelling or ballooning and frightens one who has not seen it before. It, however, subsides in several days.

A narrow strip of gauze is inserted into the sinus to facilitate the drainage of blood during the first twenty-four hours, after which it is removed.

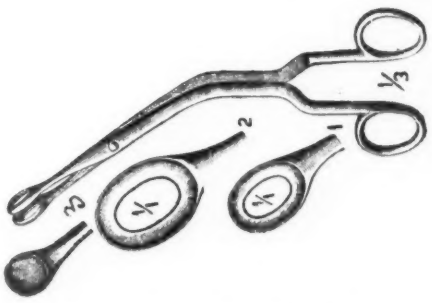

Fig. 7. Luc's forceps. Three types.

It is very seldom that any external swelling takes place in the region of the operation. The patient is kept in the hospital over night. He is permitted to resume his usual occupation within three to seven days.

The sinus is lavaged daily by the surgeon, and as soon as possible the patient is taught to do this himself. If there is a tendency for the duct to close, I insert dilators (Fig. 8) before inserting the cannula for irrigation. A 20 per cent solution of silver nitrate applied to the nasal duct with an applicator will destroy the granulation tissue. If the discharge does not diminish, it is wise to apply to the sinus strong solutions of argyrol or weak solutions of silver or iodine. Occasionally it is necessary to remove granulation tissue, when the silver is inadequate, for which purpose I use a round tapering rasp (Fig. 9). This is done in the office after cocainizing.

The intranasal frontal sinus operation should be performed under strict aseptic precautions. There is much room for improvement along this line in rhinology. No matter where we go we

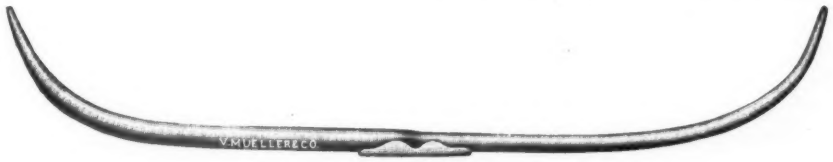

Fig. 8. Dilator.

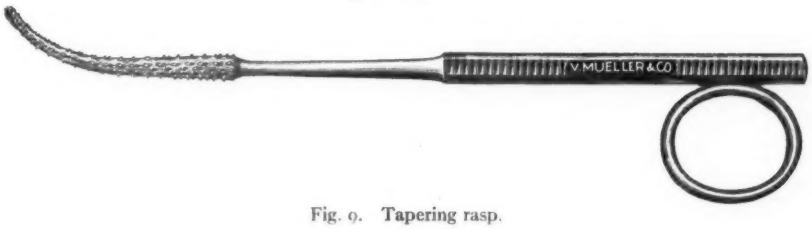

Fig. 9. Tapering rasp.

see nose operations performed without aseptic precautions, just because the idea is prevalent that since there are already so many germs in the nose there is no need of doing a clean operation. This is a great error, and whenever we hear this statement we should resent it vigorously.

Years ago there may have been some excuse for carelessness in our technique, but today with our added experience when we are operating in close proximity to the meningies it is high time that we learned the art of doing absolutely clean surgery.

PROSTATECTOMY

A Clinical Study of Fifty Cases with Particular Reference to Postoperative Treatment[1]

By W. B. DAKIN, M.D., Los Angeles
Instructor in charge Genito-Urinary Clinic, University Southern California; Attending Genito-Urinary Surgeon, Los Angeles County Hospital

BUT few surgeons can say of the majority of their operative cases, "a complete and uninterrupted recovery." Especially so is this of prostatic surgery. It has been my observation that many prostatectomy cases are left almost entirely with the nurse and interne or just the opposite — the surgeon and assistants do too much. By this I mean hypodermics, medicine per month, Murphy drip per rectum, or last, but not least, too extensive or frequent manipulation of the drainage system.

Pre-operative treatment. The success of post-operative treatment begins with the pre-operative stage. With the pre-operative treatment the patient can be exhausted with rules and treatment.

In this series of cases the pre-operative treatment averaged a little over two and a half weeks, the longest period being two months. After whatever procedure was necessary to establish good bladder drainage and bodily elimination, the patients were allowed to live as had been their former habit. They were not annoyed with rules of diet or restriction of the use of tobacco. They were encouraged to keep out of bed, take as much of a daily walk as their strength would permit, and to keep out in the sun as much as possible. In every instance their strength improved and their daily exercise increased. Often as their day of operation approached they would ask: "Why should I be operated upon because I feel as well as I ever did?" Occasionally one of these patients would leave the Hospital under the impression that an operation was entirely unnecessary.

REVIEW OF CASES OPERATED ON

The average age was 68 years, the youngest being 43, and the oldest 93. The number of cases between 40 and 50 was 3; 50 and 60, 5; 60 and 70, 24; 70 and 80, 13; 80 and 90, 4; 90 and 95, 1.

The most common presenting symptom was frequency and dysuria. There was complete retention in 11 cases, and catheter life had been followed in 32 of the 50 cases. One patient had practiced self-catheterization for seventeen years. There was complete retention during this time. This patient was 87 years old. He made a good recovery, and left the hospital in three weeks.

The average amount of retention was 458 cubic centimeters. The largest amount being 1,800 cubic centimeters, 7 cases having only 60 cubic centimeters. Those with the small amount of retention were as well relieved of their symptoms by the operation as were the more marked cases. Five cases had suprapubic puncture, it being impossible to pass the urethral catheter.

The average duration of symptoms before operation was three and a half years, the shortest period being three days with acute retention.

Complications of other organs of the body. In order of frequency, arteriosclerosis, renal insufficiency, inguinal hernia, myocarditis, valvular trouble, asthma and bronchitis, vesical calculi (one of the 3 cases having 34 stones), epithelioma of the face, cirrhosis of the liver, double hydrocele, sacral decubitus, and 2 cases of diabetes, 1 having 2.5 per cent sugar. Both diabetic cases recovered.

Diagnosis. Rectal examination was found to be a poor indicator of the real amount of prostatic tissue present. Several of these cases had a large amount of prostatic tissue in the bladder and very little to be felt per rectum. It is the author's opinion that cystoscopy should not be insisted upon if the general condition of the patient does not warrant it, the diagnosis to be made in some other manner. No contra-indications being

[1] Read before the Pacific Coast Branch of the American Urological Association, California State Medical Meeting, Fresno, California, April 19, 1916.

present, a patient with urinary symptoms suggestive of prostatic enlargement with little or no prostatic tissue to be felt per rectum should be cystoscoped, even though spinal or some other form of anæsthesia is necessary. Occasionally this procedure will avoid a few embarrassing and complicated moments at the operating table.

About 25 per cent of these cases were brought to the hospital in the ambulance with an enormous retention and several of the cases in a semi-comatose condition. Not very promising material from which to expect a low mortality rate, whether operated on or not.

Functional kidney tests. Phthalein was the functional test of choice, however, an earnest endeavor was made to check up with urea estimation and general urinalysis. In every case of delayed appearance or a markedly decreased output of the dye the urine showed corresponding evidence of renal impairment. Four cases of marked kidney impairment were operated on because long-continued pre-operative treatment did not improve them, and their general condition was gradually getting worse.

With careful postoperative attention three recovered, but the fourth died within 72 hours.

Anæsthesia. Spinal or nitrous oxide and oxygen has been given the last year. Novocaine was used for the spinal until we were unable to procure more. Lately tropocaine has been used.

Operative technique. The usual operative procedure for suprapubic prostatectomy was followed. The abdominal and bladder incisions were perhaps a trifle higher than usual, and considerable care taken to suture muscle and fascia in closing the abdominal wall. The incisions were only large enough to permit a small bladder exposure. Usually only one or rarely two skin sutures were needed.

Postoperative treatment. Patients that have been built up in a general way, and operated on carefully with a good anæsthetic as a rule give no trouble. If a bladder drainage tube has been placed too far down into the bladder and presses against the bladder base or muscle, and skin sutures have been carelessly placed, we must expect pain and discomfort.

Whatever bleeding there may be occasionally forms into small clots in the tube. If the drainage continues into the siphon bottle regardless of the appearance of clots in the glass connecting tube the patient is better off left alone. This is especially so when the surgeon needs to depend on an inexperienced nurse. The operator should, if possible, give the patient his personal attention the first 24 or 48 hours if any manipulation of bladder drainage is to be instituted.

After the operation the patient is placed in a warm bed the head of which has been elevated 6 to 8 inches. As soon as possible the drainage tube is connected there by lessening the possibility of clots forming. As soon as the patient is comfortably settled in bed he is encouraged to drink a glass of egg-nog to which has been added eight cubic centimeters of brandy.

The first day or two the patient is left strictly alone, except for minor adjustments of bedding to make him more comfortable. Only occasionally is it necessary to change the abdominal dressings. On the second day the tube is removed from the bladder and as small a urethral catheter placed in the urethra as will carry the drainage. Cases with considerable mucopurulent debris in the bladder will require a larger urethral catheter.

Only 5 cases of this series were unable to comfortably carry the urethral catheter. These patients were allowed to drain through the suprapubic opening. By means of intermittent urethral catheter drainage these cases were able to carry a catheter in a few days.

By keeping suprapubic wounds as dry as possible and clean of slough whenever the drainage tube has caused slough to occur, and by firmly supporting the wound with a small strip of zinc oxide adhesive and a good abdominal binder, the patient will be made more comfortable. With these cases primary union will invariably occur along the line of suture and with the occasional stimulation of the remainder of the wound with silver nitrate, complete union may be expected from one to three weeks earlier than usual.

After the second day, infected bladders are irrigated through the urethra and suprapubic wound. Clean bladders are irrigated only every second or third day. About the seventh day when the bladder-wound is apparently nearly closed, the irrigations are carried on by return flow through the urethral catheter. With these cases the average time of closure of the bladder wound was nine days, and complete closure of the abdominal wound in seventeen days.

THE CENTRAL-EYED NEEDLE IN SURGERY

By PERCIVAL P. COLE, M.B., F.R.C.S. London, England

THE useless complication and modification of instruments is undoubtedly to be deprecated. The only justification for altering the construction of such a fundamental tool as the surgical needle is that a good purpose shall be served thereby. The tendency of modern surgical technique is to become more rigid in an endeavor to reduce infection from all possible sources to a minimum. This tendency is reflected in the altered type of the commonest surgical instruments. The slow but steady supersession of the short five-inch artery forceps by longer and more powerful patterns, is a prominent instance. The surgeon has been accustomed to gauge the efficacy of his technique by the presence or absence of frank suppuration. The absence of frank suppuration is no proof that sepsis has been eliminated. Fortunately, or unfortunately, the margin for error in most operations is considerable, and it must be commonly known and noted, that apparently the same immediate results accrue to the particular and careless alike. But even in operations where such a margin for error obtains, it is probable that the operator who cherishes an ideal in aseptic technique will secure the best results. The remote postoperative results, for example, in a series of laparotomies, one is inclined to think, would testify in no uncertain way as to the original methods adopted. Intestinal adhesions, ventral herniæ, and stitch sinuses are concrete punishments for technical sins.

But the falsity of the generally accepted gauge is demonstrated more forcibly in operations where the margin for error is much smaller. I refer to what may, for the sake of brevity, be called foreign body surgery, including operations such as plating, grafting and filigree imbedding. Many observers during the progress of the present war, have noted the recrudescence of sepsis when with a soundly healed wound an operation has been undertaken to remove a metallic foreign body which had been retained. This is no new observation, for similar phenomena, differing in degree, rather than in kind, are met with in civil practice, associated too with the introduction of metallic bodies, such as plates and filigree. How frequently obvious suppuration occurs in fractures treated by the open method it is difficult to determine, but it is certain that suppuration ensues more often than many operators would care to admit. The removal of plates is by no means rarely rendered necessary in cases with no evidence of obvious sepsis. I have on several occasions had to deal with plated fractures where, after a considerable period had elapsed, no union had occurred, although the wound in the soft parts had soundly healed. What is found in such cases? The plate is loose, as are the screws, and these are surrounded by a discolored necrotic grumous material which is also found between the bone ends. The plate is removed, the cavity curetted, and union, as a rule, promptly occurs.

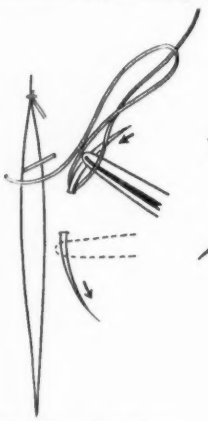

Fig. 1. Modified continuous Cushing.

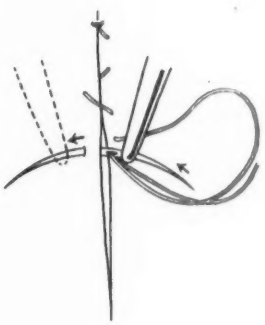

Fig. 2. The same as Fig. 1.

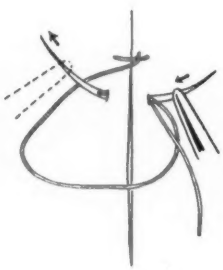

Fig. 3. Lock stitch.

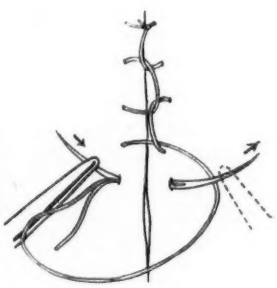

Fig. 4. Lock stitch.

Can there be any reasonable doubt that this condition is due to sepsis, and that the surgeon is at fault?

Some cases of filigree implantation bear witness to the same effect. The wound heals soundly and all seems well. After a varying interval a sinus forms, due to suppuration arising in connection with the foreign body introduced. The surgeon may blame himself, but he is more likely to ascribe it to some idiosyncrasy of the patient, or to what he is pleased to call auto-infection. Many surgeons regard the guarding of skin edges and measures adopted to eliminate as much as possible the handling of the wound, ligatures, and sutures as the sheerest surgical pedantry. The available evidence tends to show that the more rigid the technique of the operator the fewer will be the failures of the types herein discussed.

The aim of the central-eyed needle is to help toward the attainment of this technical ideal by assisting to reduce handling of needles, wound, and ligatures to a minimum. For its use a needle-holder is necessary. The jaw should preferably be lined with brass or lead, but any ordinary pair of pressure forceps serves the purpose. The fundamental principle involved is to enable the return stitch to be made with the same grip that pulls the needle through, thus obviating the readjustment that must necessarily be made at each stitch if the ordinary terminal eyed needle be used. To those accustomed to the ordinary needle this tendency to readjustment is difficult to conquer, as the action through long use has become automatic. With a little practice, however, a ready manipulation of the central-eyed needle can be easily attained. Its use is not recommended for intestinal suturing, as in this case any form of needle holder is cumbersome and unsatisfactory.

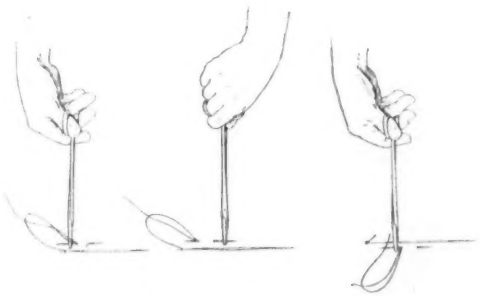

Fig. 5. Ordinary Cushing.

The diagrams illustrate a few methods of stitching and mode of use. With the curved needle it will rarely be possible to utilize the ordinary overstitch, but the entire elimination of this stitch from surgical technique would be no great loss. The needle is necessarily rather weak at its center, but only moderate care has to be exercised to avoid breakage provided the needle is sharp. Owing to this weakness very fine needles are found to be impracticable. To prevent the needle from constantly becoming unthreaded the suture should be passed through the eye twice, or a double suture should be used, the two ends being knotted together. If the tissues to be sutured are tough, or the suture material thick, the latter plan is undoubtedly the better. Owing to the conditions at present existing there is considerable difficulty in obtaining these needles in any but a few selected sizes.

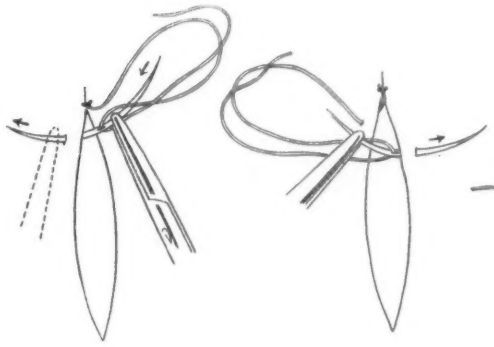

Fig. 6. Postmortem stitch.

Fig. 7.

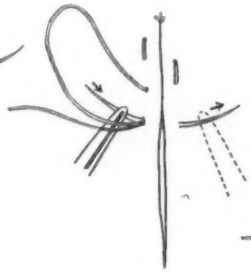

Fig. 8. Continuous Halsted.

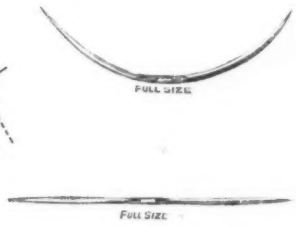

Fig. 9. Curved and straight needles.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis, Missouri

IT seems but yesterday that we listened to, or participated in, heated discussions as to the probability of the ovary possessing a metabolic function in addition to that of producing eggs — and today the teaching of internal secretions is so firmly and definitely established that it has given us an entirely new outlook upon medicine. Biedl's work on the experimental side and Falta's book on the clinical aspect of internal secretion approach the subject from a general viewpoint. The new book by Bell[1] covers a special phase of the problem.

In this monograph of some 200 pages the author has set for himself the tasks of demonstrating the fact that the reproductive functions in the female are directed and controlled by all the organs of internal secretion acting in conjunction. He terms "sex complex" the sex characteristics and the functions appertaining to them, and this sex complex, he contends, is produced and maintained by a definite genital system formed by the association of all endocrine glands. Every fertilized ovum is potentially bisexual; one hardly needs any further proof than the embryological remains of the latent sex which always exist in the genital ducts. Whether the ovum will develop into maleness or femaleness is, according to the prevailing belief, dependent on the sex glands. This exclusive influence of the gonads upon the determination of the sex is emphatically denied by the author. "The ovaries alone are not responsible either for the primary or secondary female characteristics . . . . many, if not all, the organs of internal secretion influence the genital characteristics; and . . . . all the endocritic organs, as well as the gonads, have normally a primary tendency to produce either masculine characteristics and functions, or feminine." This last theory presupposes another assumption, namely, that in the two sexes the endocritic organs — other than the generative portions of the gonads — possess functional as well as structural differences. This, then, is the thesis: that femininity itself is dependent on all the internal secretions. The *modus operandi*, as we read the book, seems surprisingly simple. The femininity-producing secretions call forth responses in the metabolism; the most important and obvious ones of these are associated with the metabolism of the lime salts, and this thought recurs throughout the book like a red thread. If the perfect harmony of the endocrine glands is disturbed, the metabolism of the lime salts is affected and in consequence the "sex complex" becomes deranged. This applies not only to physical conditions but also to mental and psychical phenomena both in health and disease.

The temptation is great to quote many pages from the book, but the editor would probably enter his veto, and it is obviously impossible within the scope of a short review to show just how the author proceeds to support his contentions from literature and on the strength of extensive personal investigations. Let it suffice to say that we have to deal with a work of absorbing interest and prime importance. By associating disjointed facts it renders many phenomena clear which heretofore have been obscure. It leads us into intricate problems which make the gynecology of today appear crude and empirical. It points the direction in which the future of our specialty is likely to develop, and acts as a fruitful stimulant to further researches into this newly-opened field of medicine. Moreover, it is written in so attractive a style that the study of the book affords a keen literary pleasure. The numerous histologic pictures are most instructive and the colored photomicrographs are of unusual excellence.

Even the warmest appreciation of the book does not necessarily imply that we are ready to subscribe to all the views set forth by the author. We may grant the plausibility of many of his arguments, and may even welcome a new and comprehensive theory in a field which has been obscured by ephemeral speculations. But there are yet too many gaps in our actual knowledge; the literature, vast as it is, is still too contradictory, and our methods of investigation are far from perfect; and so it seems advisable to suspend our complete acceptance of the author's theory. However, as a working basis it may well serve the purpose of our science until further experience may have vindicated its correctness. It would have been a herculean, perhaps an impossible task to consider the entire literature on the subject. Yet, we should have liked to see a reference to the important contributions by such men as Loeb, Falta, Pogres, and Hofstaetter. Bell's book has had a precursor in an extensive monograph by Novak, of Vienna, who, in 1912, suggested that the development of sex characteristics depended not only on the ovaries but to an even greater extent on other

[1] The Sex Complex. A Study of the Relationships of the Internal Secretions to the Female Characteristics and Functions in Health and Disease. By W. Blair Bell, B.S., M.D. (Lond.). New York: William Wood & Co., 1916.

endocrine glands. This work, which apparently has escaped the attention of our author, serves to strengthen in many respects the stand taken by Bell. The book before us must needs appeal strongly to an unusually large and diversified circle of readers, and while its usefulness to gynecologists, physiologists, and pathologists is evident, it is not too much to say that its study would greatly benefit the medical profession at large.

THAT writers of modern gynecologic textbooks can no longer ignore the problems of internal secretion nor consider them largely of theoretical importance is well shown by Graves, who has just published a work of exceptional value.[1] The first part of this tome deals with the physiology of the pelvic organs and with the relationship of gynecology to the general organism. The author, who proves himself abreast of the latest advances in medical thought, introduces here a consideration of the rôle of the several endocrine glands in gynecology, and while the available space for this subject is of necessity limited in a general work on gynecology, a happy faculty of lucid, albeit brief expression together with a remarkable expository skill, have enabled the author to give to the reader a clear picture of the present status of the question, and the frequent reference to the practical application of the knowledge thus far obtained cannot fail to arouse in the student the desire for further study. Of equal importance are the ensuing chapters on the relationship of gynecology to all the other organs of the body, a relationship which should be self-evident but seems too often neglected in the teaching and practice of our specialty.

The second part of the book includes a description of those diseases which are essentially gynecologic, and the third part is devoted exclusively to the technique of gynecologic surgery.

Thus, a variety of purposes is taken into consideration in this work. Parts I and III serve the needs of the advanced student and the general practitioner who includes gynecologic patients in his clientele. Part II furnishes the undergraduate student who is taking his initial course in gynecology with the necessary ground work. There is this unusual feature in the book: all the 303 half-tone and pen drawings have been made by the author himself. Their high degree of perfection implies power of accurate observation, and this same power manifests itself throughout the book in the way in which important points are brought forward and unessential ones relegated. The description of operative procedures both in the text and by way of illustrations is convincingly clear, so that the student may be safely guided. There are also 122 microscopic drawings scattered through the second part. They show the author's firm foundation upon pathology and they are so exceedingly well done that, with the help of the descriptive legends appended to them, they represent a veritable course in gynecologic histology.

The dignified appearance of the entire work corresponds to the prominent position it will hold among the best textbooks on gynecology.

FROM the Medical School of Glasgow two books relating to our science have emanated within a short time of one another. Munro Kerr[1] publishes the third edition of his *Operative Midwifery*. In this book of more than 700 pages the well-known author offers much more than the title would indicate. He gives us a fairly comprehensive treatise on the pathology of pregnancy and labor and discusses the causes, symptoms, and diagnosis of the various conditions that may produce dystocia. Greatest emphasis is naturally laid on therapy, and the very extensive experience of the author and the candor with which he acknowledges the lessons taught him by his failures make the book extremely valuable. The old adage that we learn more from our mistakes than from our successes applies preeminently to obstetrics. This personal note strikes me as very attractive. The "perpendicular pronoun" is objectionable only when it is employed solely to herald personal achievements; but when it is used, as in this book, chiefly to denote the response to stimuli received from other workers in the field, it is most useful and fully justifies a new textbook on obstetrics where there is already such an embarrassment of riches. There are 37 chapters, and each represents a separate article in which the author tries "to indicate what is becoming more apparent every day, that the art of midwifery can no longer be considered a subdivision of medicine but must be regarded as a branch of surgery requiring a thorough knowledge of surgical principles."

Only a cursory selection of questions raised can be indulged in at this time. In classifying the causes of dystocia, the author ascribes less importance to faults in the expulsive forces than is commonly assumed. Difficulty and delay in labor are more frequently due to some departure from the normal in the pelvic cavity or to the position or attitude of the child. A rectal examination is rarely, if ever called for in obstetric practice. Chloroform is almost exclusively employed in England as the anæsthetic in parturition. The results of injections of scopolamine and morphine in the Glasgow Maternity Hospital have been fairly satisfactory and are being continued at the present time. Kerr is an enthusiastic advocate of the axis-traction forceps, but warns against undue amount of traction. Extreme force means that the instrument is either used unskillfully or that it is unsuitable and that some other operation should be substituted. If the retraction ring of Bandl is distinct, forceps should be employed only very occasionally and with great care; and in contracted pelvis if the head is still movable, forceps is absolutely unjustifiable. It is

[1] GYNECOLOGY. By William P. Graves, A.B., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Co., 1916.

[1] OPERATIVE MIDWIFERY. By J. Munro Kerr, M.D., C.M. (Glasgow). 3d ed. New York: William Wood & Co., 1916.

interesting to note that England seems to be the only country where forceps is applied in the left lateral position as a matter of routine. In considering the question of cæsarean section in deformed pelves in suspect or infected cases, the author is convinced that craniotomy should sometimes be chosen even though the child be alive. So long as hysterectomy is the only alternative to craniotomy in such cases, it is questionable if we choose wisely if we select the former operation.

To sum up, this book appears to us a real guide to the difficulties and complications of obstetric practice and may safely count on a warm reception from the profession in this country.

THE same prediction cannot be made unreservedly for the second book from the Glasgow School.[1] This *Manual of Gynecology* differs in no essential from other short textbooks on gynecology, and in so far as it acquaints students and practitioners with the present status of our knowledge, it is fully acceptable. Only where it introduces the personal technique of the author, it is likely to meet with some opposition, at least in this country. The recommendation, for instance, to dilate the urethra for digital exploration of the cavity of the bladder would seem to us rather antiquated and we would wish that the author when speaking of inspection of the bladder would not limit himself to Kelly's endoscope but would consider some of the excellent cystoscopes which modern urology has placed at our disposal. Bimanual examination of the pelvic cavity, according to the author, should seldom be omitted,— we would substitute "never" for "seldom." In discussing perineorrhaphy, he advises the beginner to place a finger in the rectum occasionally as a guide to the position of the rectal wall, and in the repair of complete lacerations he unites the torn rectum with catgut sutures which are tied within the rectal passage. Both these procedures seem to us to threaten an aseptic course of healing. Even the frequent use of a 5 per cent solution of carbolic acid which is recommended for the surgeon's hands will not remedy matters, not to mention the serious consequences it may have upon the surgeon's kidneys.

In advanced cases of cancer of the cervix the author suggests curettage of the growth and treatment with a strong antiseptic, such as carbolic acid, for several days before the abdominal operation is performed. We believe that in this country, operators have very generally profited by the experiences of Wertheim, Bumm, and other pioneers in this field to the effect that curettage and cauterization should be done immediately prior to operation lest cancer particles be precipitated into the general circulation.

The recommendation of the bilateral removal of normal ovaries in certain instances for *Mittelschmerz* is almost certain to create a decided protest. The author fails to realize that this intermediate dysmenorrhœa, which, by the way, is rarely severe, is but the expression of ovulation as we have recently learned from Fraenkel and others. "In acute gonorrhœal infection of the uterine endometrium, the cervical canal should be dilated. The interior of the uterus should then be swabbed with dry gauze before the application of pure carbolic acid." Granting that our own ultraconservative treatment does not yield brilliant results, one may well wonder whether ascending gonorrhœa or uterine atresia would more frequently follow such active therapy.

IN order to hold its own in the galaxy of excellent textbooks of which America may justly be proud, a new work on obstetrics must needs have a good many attractive features. It is, then, a pleasant surprise to find among the books received for review one that possesses an individuality all its own and exhibits a number of qualities which will make its general acceptance a matter of certainty.[2] The author has succeeded in pouring new wine into old bottles. He has omitted the traditional sections on embryology, which has become a science in itself, and can be adequately treated only in a separate work. The section on anatomy is omitted because such preliminary knowledge must be taken for granted in every student of obstetrics. Fœtal monstrosities, interesting as they are, are discussed but briefly and only in those forms which are likely to occur in daily practice; the description of rare developmental anomalies is left to special works on teratology. Of the theory of pure obstetrics only the essentials are given, "about as much as the student ought to know, or is likely to remember; enough, also, to serve, if desired, as a ground work for further study."

Having thus gained a good deal of space, the author concentrates his attention upon what the practitioner actually needs in obstetrics, the physiology and pathology of pregnancy, labor and puerperium, the methods of examination, the diagnosis, and management of normal and abnormal conditions. A fluent writer, he knows how to paint vivid word pictures that in clearness and completeness leave nothing to be desired, and as an experienced teacher he does not hesitate to repeat not once but several times the points he wishes to impress upon the reader's mind. The same object is achieved by short summaries at the end of several of the therapeutic and diagnostic chapters. Where so much is good it is, perhaps, unnecessary to point out a single chapter, and yet, the section dealing with the indications for, and the technique of, the induction of abortion and of premature labor appears particularly praiseworthy.

Like every other textbook, this, too, is to a certain extent a compilation; but the individual attitude is strong throughout and where traditional views and advice do not coincide with his own conception, the author tersely registers his dissent.

[1] A MANUAL OF GYNECOLOGY. By S. J. Cameron. London: Edward Arnold, 1915. New York: Longmans Green & Co.

[2] OBSTETRICS, NORMAL AND OPERATIVE. By George Peaslee Shears, B.S., M.D. Philadelphia and London: J. B. Lippincott Co., 1916.